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"The Builder" Student's Series.

SPECIFICATIONS

FOR

BUILDING WORKS

AND

HOW TO WRITE THEM.

A MANUAL FOR ARCHITECTURAL STUDENTS

BY

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PREFACE.

This Manual is written with a view to meet the requirements of the architectural student, to show him how he should write a specification, so that when he has learnt the method and general principles, he may apply them to the particular exigencies of any building he may design. The examples given are intended to act as illustrations, not as precedents to be exactly copied in every instance. There is a bad practice existing in many architects' offices of copying old specifications, with some modifications, for new work. Such a practice leads too often to the omission of important items, to the inclusion of irrelevant matter, and to vague and indefinite description. A mere collection of precedents is therefore too apt to prove a pitfall for the student, who should rather take it as an axiom that each well-written specification will fitly apply only to the one design for which it is intended and to no other. Once secure in his own mental equipment, the architect has no further need of guides and precedents, but will produce better and more satisfactory work by the independent exercise of his trained faculties and intelligence.

The book is mainly a reprint of a series of articles which appeared in the Students' Column of *The Builder*.

FREDERIC R. FARROW.

7, New Court, Lincoln's Inn,
May, 1898.

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Specifications for Building Works,

AND HOW TO WRITE THEM.

CHAPTER I.

GENERAL PRINCIPLES.

BEFORE commencing to write a specification the student should endeavour to obtain a clear comprehension of the object and uses of such a document, and then proceed to consider how he can best fit his work for its purpose. The primary object of a specification is to supplement and elucidate the drawings, so that the workmen who have to carry out his designs may completely understand the architect's intentions. It, therefore, especially deals with the quality of materials and workmanship, and describes the sizes and forms of those items which cannot be conveniently shown on the drawings. It may include a description of what is shown on the drawings, but, speaking generally, it is not advisable to repeat or attempt to repeat one document in another. Some things can be far better shown on drawings than described verbally in a specification, and the attempt to include in the latter what is already better expressed in the former, is liable to confuse rather than to inform the mind of the workman. Although the specification universally forms part of the documents on which the contract is founded, it should be remembered that the specification is rather for the use of the foreman, either on the works or in the shop, than for the master builder in his office. The conditions of contract are therefore better omitted from the specification, and made a separate document, which can be kept in the contractor's office.

The predominant characteristic of a specification should

be precision. Every item with which it deals should be so clearly defined and explained that there can be no possible doubt as to what are the intentions of the architect in respect of every detail, and hence what is included in the contract. Precision can only become the characteristic of any particular specification through the exercise of that quality by the writer. He must therefore possess a thorough knowledge of construction, and be able in his mind's eye to see into the innermost recesses of every part of the building, and to follow the consecutive processes by which the work arrives at completion. He must have a competent knowledge of materials, so as to be able to express precisely the quality that he expects. He must know completely the full intentions of the designer in respect of every particular. The right man, therefore, to compile the specification is he who makes the design, and the practice of deputing this work to another, be he quantity surveyor or assistant, is one that is discreditable to any architect worthy of the name, must result in a loss of efficiency, and often breeds future trouble out of all proportion to the relief that appears to come from shirking the initial duty. If he would attain precision, let the student be very chary of using terms of general but indefinite meaning, such as "best," "necessary," "sufficient," "proper," and the like, which are but too common in many specifications, and usually indicate clearly nothing but the ignorance or indolence of the writer.

Equipped with the necessary knowledge and the determination to be precise, clear and accurate, the student should look carefully through his drawings and jot down, as memoranda, the headings of the various items in each trade which he is to specify. Then he can take these memoranda and, after numbering them in the order in which he intends them to follow in the specification, proceed to deal with each item in turn. To facilitate reference, each item should have a marginal note or heading, and if the specification is a long one, it is worth while to make an index of these headings. It is advisable to adopt the same order, both of trades and of items in each trade, in all one's specifications; and it is just as well to adopt the order of trades usual in specifications and bills of quantities; whilst for the individual

items, as good an order as any is to arrange them, as nearly as may be, in the order in which they are to be executed. As materials have to be provided before work can be done on them it follows that in each trade a commencement will be made with a description of the materials for that trade. Then comes a general description of work, and following this the special items in proper order. Where a general requirement stands for all the items of a class it is well to place this general requirement before the description of the particular items, thus: "All frames to external doors to have iron dowels, &c.," should precede the detailed account of the various external doors. The adoption of this practice makes for brevity, and brevity, as far as is consistent with precision and thoroughness, is a desirable feature in a specification, rendering it easier for reference, and more likely to be thoroughly read and remembered.

Although the arrangement of the various items in a specification will naturally be grouped under the different trades, it is advisable not to follow such a division with the literal exactness observed in a bill of quantities, but rather to keep together the description of all the adjuncts of each part. Thus, for example, in describing a door, the linings, architraves, and ironmongery should be included. Indeed, it is quite possible to write a good model specification, totally ignoring the usual division into trades, and grouping the various items under headings of the various parts of a building, as walls, roofs, floors, ceilings, windows, doors, fireplaces, water supply, sanitary fittings, &c. In such a system the heading of "roofs," for example, would comprise a description of carpenter's work in the timbering, battening, and boarding; slater's or tiler's work; plumber's work in gutters, flashings, &c. The adoption of this system implies, of course, that there is one contractor only for the whole of the work, and that the Scotch practice of letting out the work in different trades to different contractors is not followed, but as the single contract system is practically universal in England, and sub-contracting is out of favour both with architects and trades unions, there is little advantage in favour of the older system of specifying by trades.

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To facilitate reference between drawings and specifications, it is a good plan to number all the openings on the plans—doors, windows, fireplaces, &c. In this numbering no great attempt should be made to keep the sequence full. Let the doors begin with, say, number twenty-one, the windows with fifty-one, and fireplaces ninety-one, even if there be no more than, say, a dozen doors and a score of windows. The rooms of which there are no special names, as bedrooms, may be lettered bedroom A, bedroom B, and so on.

The student is now prepared to commence the actual work of writing his specification and will head it thus: "Specification of works required to be done in the erection of a *house* at for in accordance with drawings numbered 1 to prepared by Mr. of the architect referred to in this specification. January, 1898."

Then begin with

"PRELIMINARY AND GENERAL."

Under this heading include :—

Notices and Fees.—Give all requisite notices to Local and other Authorities, obtain all licences, and pay all fees.

Setting-out.—The contractor is to set out the whole of the works in accordance with the plans, and he will be responsible for the correctness of the setting-out, and is to amend the same if it shall be found by the architect to be incorrect.

Dimensions on Drawings.—Figured dimensions are, in all cases, to be taken in preference to scale, and the large scale details to be followed in preference to small scale general drawings. In the event of any apparent discrepancy between the drawings, or between the drawings and this specification, the contractor is to ask for an explanation from the architect before proceeding.

Drawings to be returned.—If this is desired, stipulate accordingly.

Hoarding.—Specify what height of hoarding is required, with its fans, gates, planked footway, and rail, to be to the

satisfaction of Local Authorities, and removed at completion. State whether advertisements will be allowed.

Roads and Footways.—State whether the contractor is to take up paving and form temporary roads or footways, and reinstate, or whether he is to pay Local Authority for doing the work.

Temporary Enclosure.—If it is desired to keep building operations within a limited space, state how much of site is to be temporarily enclosed with post-and-rail fence, to be removed at completion.

Scaffolding.—The contractor is to supply all scaffolding and plant required for the works, but is not to bring on to the site any other building material or plant not required for these works.

Old Drains, Cesspools, &c.—Carefully search for and open all disused drains, cesspools, &c.; empty cesspools, remove drains, and fill up with concrete.

(N.B.—As this is a very speculative item, it is well to provide a definite amount of digging and concrete to be so used if required.)

Watching and Storage.—Supply all requisite watching by day and night for the whole of the building and works till the completion of the contract, also the requisite storage and safekeeping of all stoves and other fittings during and after delivery.

Water and Lighting.—Pay all charges for water and lighting required for the works during the erection of the building, and supply, alter, and remove, as may be required, all pipes and fittings, and pay fees for the necessary connexions. The contractor will be required, before receiving his final certificate, to produce receipts for water and gas.

(N.B.—This last clause is desirable to prevent the employer being dunned by water and gas companies after the completion.)

Attendance.—Each trade is to attend upon, cut away for, and make good after all others, and to perform all work in the nature of jobbing work that may be required. The contractor is to afford facilities to any other tradesman employed by the architect in the building, and to provide scaffolding and attendance as may be required.

Provisional Sums.—In all cases of provisional sums of money and of any specific quantities of work which are included in this specification, the architect shall be at liberty to direct the application of the sum or to deduct all or any portion as the case may require.

The amounts included in this contract as provisional sums are exclusive of contractor's profit, carriage and fixing, unless specially included.

(N.B.—Provisions are frequently a cause of trouble at the final settlement. Instead of the clause given, it may be stated that the p.c. amounts include a certain profit of 10 to 15 per cent. for the contractor, or that they are "list prices," but this does not always save the trouble. The specification should define the basis on which p.c. amounts are to be treated, and the architect should adhere rigidly to the basis he lays down in his specification.)

Protection of Work and Materials.—Protect all materials and finished work from damage by weather, carelessness of workmen, or other cause, and make good any damage that may occur. This stipulation is to apply to materials and workmanship of any person employed by the architect as well as that of the contractor.

Latrines.—Provide latrines for the use of workmen, taking the necessary precautions to prevent same from becoming a nuisance; empty, remove, and disinfect with hot lime their site at completion.

Office.—If desired for clerk of works or architect, this should be specified, with a stipulation that the contractor is to provide firing, light, and attendance, and remove at completion.

Sand and Gravel.—State whether the contractor is to be allowed to use the sand and gravel from excavations on the works, and whether or not he may remove any from site.

Curiosities.—A similar stipulation should be made.

Removal of Rubbish.—Remove and cart away all superfluous earth and rubbish as it accumulates and at completion, together with all plant and superfluous materials.

CHAPTER II.

EXCAVATOR.

IN dealing with this portion of the work it is advisable to prepare the site plan with rather more care than is too often done. The determination of a datum line and the careful levelling of the site before any work is commenced, and, indeed, before the plans are finally settled, will materially assist in producing accuracy in the arrangement of, and contracting for, the excavator's work. The architect should determine what are to be the levels at which the ground is to be left at the completion of the works by the contractor. The simplest way is to prepare a block plan of the site with the levels marked in different colours, say blue for those existing before the work is begun, and red for those to be left at completion. If the site is at all irregular in its surfacing before the building operations, or is intended to be so after them, it is well to add sections to the site plan, or what is better to indicate contour lines. This site plan will also serve as the plan of drains, the arrangement and position of which should be determined, and shown clearly on the drawings, before the contract is made.

In order to promote even tendering amongst the competing contractors it is particularly necessary to be clear in the specification of the excavator's work. More contracts are lost and won, and more unsuspected profits made, on the excavator's trade, than probably on any other in the bills of quantities. In the interest of his client it is the architect's duty to give every tenderer an unquestionable basis on which to form his estimate, for it too often happens that a contractor whose general pricing is below his competitors is put out of court by a mistaken reading of some loosely expressed or improperly defined stipulation in a specification. The student therefore should guard against any temptation to the vagueness and indecision which are

too frequently characteristic of the part of the specification relating to the excavator's work.

The specification should state clearly what is to be done with the earth from excavations, whether it is to be used for filling up depressions or for forming banks or terraces, or whether it is to be removed and carted away. Other points we shall notice in detail, as the clauses relating thereto are given.

Levels.—The datum line shown on the drawings is 2 ft. above the level of curb at north end of site (or define by reference to an ordnance bench-mark, or some easily accessible and well-defined point). The levels shown by the blue figures on site plan are those existing, and those shown by the red figures the finished levels.

Surface Digging and Filling.—Remove vegetable soil one spit deep, and wheel and deposit at spot where marked on site plan. Remove present superfluous surface soil, and use earth for filling where required to make up finished levels, and cart away superfluous earth ; made-up soil to be well rolled with a heavy roller to finished surface.

Excavate under boarded floors to a depth of 2 ft. 6 in. below floor level, and below paved floors to a depth of 1 ft. 6 in. below floor level.

Trench Digging.—Excavate for trenches (and basement, if any) to the depths shown on drawings, and of the following widths : for 9 in. walls, 2 ft. 6 in. wide, for 14 in. walls, 3 ft. 6 in. wide (or as the architect may desire). Level and consolidate earth at bottom.

The bottoms of foundations are to be approved by the architect before the concrete is laid.

Filling-in.—All trenches to be filled in as soon as walls are above ground level. All filling in to be well punned in layers, and watered when so directed.

Pipe Trenches.—Excavate for all water and drain pipes, and fill in and pun over same as before directed.

Surplus Earth.—All surplus earth from trenches is to be removed and carted away (or otherwise, if so desired).

Pumping.—Pump or bale out water from the trenches, and keep same dry till filled in, and supply and remove any temporary drainage requisite for this purpose.

Planking and Strutting.—Execute all planking, strutting, and shoring which may be necessary for maintaining sides of excavations. The contractor will be required to cut out to a square section for concrete any trenches that may be allowed to fall in through insufficient support, and the concrete will have to be filled in to the extra width thereby required at the contractor's expense. (N.B.—Contractors are prone to neglect adequate support for sides of trenches, and it is important that trenches should have vertical sides, and the concrete be filled in to the full width of the trench.)

Concrete.—The concrete for foundations to be composed of fresh burnt blue lias lime, and ballast of clean hard river or pit gravel, broken to pass a sieve of 2-in. mesh, and clean sharp sand, and to be mixed on a clean boarded or stone platform, in the proportion by measure of one part of lime to five parts of ballast and two parts of sand, with a sufficient quantity of water; and the whole to be thoroughly incorporated and tipped into trenches. (Or otherwise describe concrete as desired.) The concrete to be filled into the full width of square-cut trenches, and not between boards.

(Then describe any other varieties of concrete for pavings and fireproof floors.)

Brick Rubbish.—The concrete under pavings to be laid on a bed of hard, dry brick rubbish, in. thick, and well rammed.

Provision.—(Specify any provision desired of digging or concrete for filling in to cesspools, &c., making it clear what description of digging and of concrete is required.)

Roadways and Gravelling.—(Specify what is to be done by the contractor, or provide a sum of money.)

Grubbing Up.—(If there are any hedges or trees to be removed and roots to be grubbed up, this must be specified.)

DRAINAGE.

Drains.—The drains to be laid as shown on plans with pipes (state what pipes are intended; but make it quite clear whether "London-made" or "tested" pipes

are wanted or not. Do not say that the pipes are to be of "approved" manufacture without indicating what will be approved, as the quality varies considerably. If there is to be a difference between the rain-water drains and the soil-drains describe it thus :—

The rain-water drains to be of and the soil-drains of all to be laid truly with joints formed and filleted with Portland cement, and the latter to rest on bed of concrete 6 in. thick, the full width of the trench).

Testing.—The contractor will be required to test the drains in the presence of the architect. (State what test will be required, whether water test, smoke test, &c., and to what head of water, lamp test, straightness of line, and gradient, &c.) If the work is within province of Local Authority, add :

The drains are to be laid in such a manner as to satisfy the requirements of the inspector to the (Local Authority).

If the drains are not satisfactory in all respects, the whole shall be taken up and relaid at the contractor's expense.

Connexion with Sewer.—Give notice to the (Local Authority), and pay their fees for making connexion with sewer. (The Local Authorities in nearly all cases now require that the connexion with sewer shall be made by them, and their charges paid for same.)

Cesspools.—(If there is no public sewer, these may be required. Then specify size, depth, and whether steined, dry, or in cement, as the case may be; also, whether cemented and made water-tight, as required by some Local Authorities. Specify the brick dome and manhole cover, and ventilation, if any.)

Soak-away Pits.—(These are allowed in some districts. Specify size and depth, whether steined (dry, of course), and whether filled with gravel, or brick, or stone rubbish.)

Lidded Pipes.—All bends and junctions, except in inspection chambers, to have lidded pipes.

Gulleys.—(Specify as required also the slippers or open channels for sink and bath waters. Also grease traps where wanted.)

Disconnecting Chambers.—Disconnecting chambers to

be built in accordance with detail drawing by in the clear, and deep. The sides to be built one brick thick in white glazed bricks in cement, and to be corbelled over at top to receive iron covers, 24 in. by 18 in. The bottoms to be formed of Portland cement concrete, in. thick, and sloped in cement to channel. (Specify also the trap, the ventilating pipe, foot-irons, air-tight manhole cover.)

Inspection Chambers.—Inspection chambers to be by in the clear (if of varied size, letter on plans and describe them separately) and without trap and ventilating pipe, but in other respects similar to disconnecting chambers.

Lamp Holes.—(Specify if any are required.)

Flushing Tank.—(Describe if any with Field's syphon or other automatic arrangement. State size and construction.)

(N.B.—With reference to special items connected with the drainage, it is generally better for the architect to decide beforehand what he means to adopt, and specify by a manufacturer's name, as So-and-so's gully trap No. , p.c. . Care should, however, be taken to find out if these special articles are kept in stock, and, if not, how long before they are wanted the order must be given, and this should be stated in the specification, as builders often do not order special articles till the day before, or even the day after, they are wanted on the works.)

CHAPTER III.

BRICKLAYER.

THIS is one of the easiest trades for which to write a specification, but, at the same time, care must be taken not to indulge too much in generalities, to which the work of this trade particularly lends itself. As before premised, begin with the materials, and follow up with the various kinds of work, thus :—

Bricks.—The bricks for walling to be approved, sound, hard, well burned, whole stocks, and no bats are to be used except where legitimately required for bond. The bricks for facing to external walls to be first quality red facing bricks of a tint to be approved by the architect. (If varieties of bricks are to be used for various parts of the building, these must, of course, be here specified.)

Lime.—The lime to be freshly burnt blue lias lime of approved quality. (If grey chalk, Dorking, Merstham, selinitic or other lime is required, state so.)

Sand.—The sand to be clean, sharp river sand from above bridge, of medium coarseness and approved quality (or pit or sea sand if desired or allowed).

Cement.—The cement to be Portland cement of Messrs. (state the selected firm) manufacture, to weigh not less than 112 lbs. (or upwards, if a slow-setting, heavy cement is wanted) per striked bushel, and ground sufficiently fine to pass 90 per cent. through a sieve of 2,500 meshes to the square inch, and to bear a tensile strain of not less than 300 lbs. (or up to 450 lbs. if very high quality) on the square inch of a briquette seven days old kept under water.

Mortar. The mortar to be composed of 1 part of lime to 3 parts of sand, to be mixed in a pug mill and prepared in quantities sufficient only for one day's consumption.

Cement mortar to be prepared as required in small quantities, and to be mixed in proportion of 1 part of cement to 2 parts of sand.

Brick Walls.—Build all walls throughout of the various heights and thicknesses shown and figured on the drawings, with all the projections, recesses, openings, &c., shown, in their proper positions. The footings of all walls to be of the number of courses shown (or of the number of courses required by the London Building Act, 1894, or by the local by-laws), each course projecting 2¼ in. beyond the face of wall or footing immediately above same. To be built perfectly level, not to rake with the ground, but to be stepped up where the levels vary, as may be directed by the architect. The drawings show, and the contract includes, an uniform depth of brickwork (7 ft.) to bottom of footings from the ground floor level, but the contractor is to follow the instructions of the architect as to the precise level at which the brickwork is to commence after the foundations have been approved by the architect.

The brickwork is to be carried up in level courses in English bond with buttered joints, and each course well flushed up. (Buttered joints are better than grouting unless this latter is done in liquid cement, and even then may be reasonably preferred.) No portions of walls to exceed 3 ft. above the adjoining parts whilst being built, and to be racked back and not toothed up. All bricks laid in dry weather to be well soaked previous to being used, No four courses to rise more than 1 in. (or 1½ in.) in addition to the thickness of the bricks laid without mortar.

Brickwork in Cement.—All brickwork in chimney stacks above roof level, all brickwork erected as piers standing alone, and such parts of the walls as are shown hatched on plans to be built in cement mortar. The half-brick walls to be built wholly in stretchers and in cement mortar.

Hollow Walls.—(If these are intended specify thus.) The hollow walls shown on plans to be built in two thicknesses, 9 in. internal, and 4½ in. external, with a 2½ in. cavity, bonded together with wrought-iron ties, dipped in tar and sanded, every (18 in. to 3 ft.) in height and 2 ft. 3 in. (18 in. or 3 ft.) apart. The hollow and ties to be kept free

of mortar droppings by haybands to be lifted as work proceeds. The damp course to hollow walls to be laid at two levels, that over inner thickness one course above that over remainder. The perpends of bottom course to be left open. Build in for ventilation of cavity (if this is desired and it keeps cavity drier) 9 in. by 3 in. terra-cotta air bricks, 3 ft. apart at bottom of cavity, and also immediately under eaves. All door and window openings in hollow walls to have immediately over arches an apron of 5 lb. lead projecting ½ in. from face of wall extending through outer thickness, across space, turned up 2 in. against inner thickness, and extending 9 in. each way beyond frame. The perpends of course immediately over these aprons to be left open.

It should be observed, however, that the utility of hollow walls is very questionable, and that they have the disadvantage of leaving hollow spaces which can never be inspected or got at, which it is always desirable to avoid if possible, in whatever portion of a building.

Facings and Pointings.—The facings to be carried out in English bond, the perpends carefully kept, and the joints pointed at completion with a neat struck weather joint in grey tinted mortar (or as may be desired. If diaper work is intended, or ornamental bonding, describe it thus). The diaper work shown on south elevation to be executed in cross bond (or Flemish, &c.) with the pattern in black header bricks from Sussex. No staining or colouring is on any account to be applied to any brickwork, and the brickwork is not to be rubbed down before pointing, but washed only with a weak solution of green copperas. (State if work in cement is to be pointed in cement, or if joints are to be raked out and pointed to match facings.)

The inner faces of walls where plastered to be left with rough joints, as key for plaster, and in other cases to be worked fair with flush joints and twice limewhited (or dinged with a wet brush and distempered to an approved tint).

Gauged Work.—(Refer to the parts where this occurs.) The to be executed in gauged work with (state the bricks and the maker selected) the moulded work to be carefully cut and rubbed to the architect's full size details.

The gauged work to be set in lime putty, with $\frac{1}{8}$ in. joints, and each course to range with a course of the backing. (If there is carving the rubbers are sometimes set in shellac. If this is desired say so.)

Arches.—The external arches on front elevation to be executed in gauged work; the remainder to be fair axed arches. The arches to fireplace openings to have two half-brick rings in cement, and wrought-iron chimney bars, $1\frac{1}{2}$ in. by $\frac{3}{8}$ in., each 18 in. longer than openings, split and turned up and down at ends. The trimmer arches to be half-brick in cement rampant arches (to avoid the use of feather-edged springers).

Chimneys.—The kitchen flue to be 14 in. by 14 in., the remainder 14 in. by 9 in., all to be pargeted with cow-dung mortar, properly cored, and finished with ———'s (state maker's name) red terra-cotta chimney pots, No. in list, p.c. each, to be bedded in brickwork for 9 in., and flaunched up in cement.

Hoop-iron Bond.—Lay throughout all walls under sills of first-floor windows a continuous range of hoop-iron bond, No. 15 gauge, $1\frac{1}{2}$ in. wide, tarred and sanded, and laid in cement, three courses in height, and one row to every half-brick in thickness of wall.

Moulded Strings, &c.—(Describe these, stating whether stock patterns are to be used; if so, refer to catalogue, and give price, or if to be purpose-made, refer to special full size details).

Plinths.—(Describe if of special brick, as salt-glazed, what the plinth course is to be, if plinth is to be battered, or any other special treatment.)

Damp-proof Course.—A damp-proof course of Val de Travers asphalte, $\frac{1}{2}$ in. thick, is to be laid in all walls, and this work is to be executed by the company's workmen (or state any other approved form of damp-proof course).

Air Bricks.—Build in where directed No. 60 terra-cotta air gratings (state colour) 9 in. by 3 in., to ventilate floors, and form proper splayed apertures for same, and render around in cement.

Copings.—(If brick copings are intended, describe them.) The coping to back wall of office building to be of brick

on edge and double tile creasing, all set and pointed in cement.

Window Sills (*if brick*).—The window sills on first floor to be executed in splayed brick on edge, set and pointed in cement, with tile course under projecting ¾ in.

Pavings.—Pave the floor of scullery with 6-in. red Staffordshire tiles bedded and jointed in cement on 6-in. bed of Portland cement concrete. Pave the coal place with hard brick-on-edge paving set and jointed in mortar on a bed of sand 3 in. thick (or as desired). The kitchen yard to be laid with ———'s granolithic (or other stated) paving, 1½ in. thick, on a 4-in. bed of cement concrete, laid to current. The contractor is to lay the concrete bed after excavating the surface soil and filling in with 9-in. bed of dry brick rubbish, and the paving is to be laid by the patentee at the p.c. sum of per yard, which is to be paid to the patentee by the contractor within fourteen days after the production of the architect's certificate.

(Similarly describe any other pavings, whether asphalte, Staffordshire brick, or other material.)

Brick Steps.—(Describe these, if any.)

Boundary Walls.—Build garden fence walls on three sides of site, one brick thick, in Flemish garden wall bond fair on both sides, and finish with half-round salt glazed brick coping, set and pointed in cement, with double tile creasing. These walls to be 6 ft. high above ground, and 1 ft. 6 in. below, with two courses of footings and 12-in. bed of concrete. Piers 18 in. by 18 in. to be built, every 10 ft. apart. Damp course of two courses of slate in cement to break joint.

CHAPTER IV.

MASON.

IT is well to begin this trade with the stipulations as to quality of material and methods of workmanship which apply to all the varieties of stone, and then to indicate what parts of the works are to be of each particular kind, giving sizes of those items which are not figured or shown on the drawings. As there should be ½ in. or larger-sized details of all the special features, the sizes of beds and heights of stones are better and more clearly denoted on these drawings than in the specification.

Materials.—All stone to be of the best quality of its respective kind, free from vents, sandholes, flaws, and other defects, thoroughly seasoned, and free from quarry sap (except in the case of those stones where the quarry sap in drying forms a protective film, in which case omit the requirement here and insert it under heading of those stones to which it applies), set on its natural bed, except where otherwise directed by this specification or the drawings, cleaned down at completion, and left perfect, all stone injured during the progress of the building by frost or other causes being taken out and replaced. All stones to hold their full scantlings, die-square at back, and no shellac is to be used on any account.

Workmanship.—All sizes of stones shown on the detail drawings, to be followed exactly, and the stonework to be put together with slate dowels 1 in. by 1 in. and 3 in. long, fitted to square cut mortises. Cramps, when necessary, to be of bronze, and run with Spence's metal. All beds to be truly level, and no stones to be hollow bedded. All joggle joints to be V joggles. (N.B.—If quarry-worked stone is allowed, say so, but stipulate that any damaged in transit is to be replaced by sound stone.)

Rubble-walling.—The walls of to be built of local limestone, from quarry, squared and brought up to level courses, not more than 2 ft. apart, and with not less than one through stone to each superficial yard. (If these walls, as usually done, are to have brick lining, specify thus:) These walls to have half-brick lining built in cement, bonded to stonework, with headers in each course, one to every four stretchers. No bond stone to be built through brick lining. The face of stones to be scabbled and joints pointed with V joint in mortar.

Ashlar-facing.—The walls of to have ashlar-facing of stone, the stretcher stones to be $4\frac{1}{2}$ in. thick, the headers 9 in. thick, with bonders in. long ($4\frac{1}{2}$ in. less than thickness of wall) in the proportion of $\frac{1}{10}$ of wall surface. The joints to have dovetailed mortises run with lead as sketch. (Sketch the shape of lead plug or dowel preferred, or specify cramps of bronze or gunmetal.)

Rusticated Work.—The quoins to be 16 in. by 24 in. on bed, set to project 2 in. from ashlar-facing with chamfer 2 in. wide around each face, and worked with snail-creep rusticated face (or other variety if desired) as directed by the architect. One specimen stone to be worked and approved before the others are commenced. (Describe also rusticated work to plinths or elsewhere.)

Arches.—(With rubble walling, arches are often used over lintels of dressed stone, if so, describe.) Turn relieving arches over lintels, the voussoirs, 12 in. deep by average width of 6 in., with scabbled face and pointing to match facing. (Arches of dressed stone will, of course, come under the heading of the particular kind of stone of which they are formed.)

Bath Stone.—The external stone work of . . . . to be of Box Ground stone, to be supplied by the Bath Stone Firms, Limited, hard and well seasoned; picked from stock by the architect or clerk of works (if so desired). (Or it may be specified that certain parts are to be Corsham Down or Monk's Park, or other variety.)

The external Bath stone work, after being cleaned down, is to be treated with "Fluate," applied in accordance with the instructions of the manufacturers.

(Then describe the internal work, if any, to be executed in Combe Down, Farleigh Down, or whatever is selected.)

Kentish Ragstone.—This, of course, is usually employed only for rubble walling. In specifying it is important to mention that the stone is to be free from "hassock," where used externally. "Hassock" is useful internally occasionally.

Chalk.—For internal work only. Specify that it is to be from the "bull head," free from veins, shells, and flints, of even texture, and not to be in less size blocks than shown on the detail drawings.

Portland Stone.—Specify the bed, generally the "whit bed," though others may be used if desired. Say that overhanging cornices are to be joint bedded. This applies also to Bath stone.

(N.B.—In specifying Portland, Bath, and similar stones be particular to say how the face of stone is to be finished, whether tooled, dragged, or rubbed.)

For steps and landings, &c., old Portland stone, if obtainable, should be specified. Usually they are described as "hard Portland." Age adds hardness, a quality in which the beds vary.

With all limestones it is well to specify that they are *not* to be set in Portland cement.

Yorkshire Stone.—By this term is usually understood the more or less laminated or flag-stones, but there are a large number of freestones in Yorkshire, as the various quarries in Huddersfield, Halifax, and elsewhere, which are useful for dressings.

Corbels and Cover Stones.—State size, whether "self faced" or "tooled," with "coped edges" where wanted.

Templates.—Give full list with size, whether "tooled" or how otherwise finished.

Steps and Thresholds.—Specify widths and depths, how much longer than openings, how finished and if "back-jointed." Particularly note whether they are to be in one stone, or if not, how jointed and joggled. Say whether they are to be built in, or cut and pinned, and made good to.

Sills.—Give size and finish, whether sunk, weathered, throated, &c.

Copings.—Give size and form, whether parallel, saddle backed, weathered or throated, and method of setting and jointing. If cramps are desired say so, quoting length and weight, and whether run with lead, Spence's metal, sulphur, or cement.

Hearths and Slabs.—Specify thickness, projection beyond opening, and description of surface, "tooled," or "rubbed."

Pavings.—State thickness, widths of courses, or average sizes of stones, surface finish, method of setting.

Stairs.—Give sizes, amount pinned into walls, describe whether solid, spandril, or built up treads and risers, if rebated or with moulded nosings, and whether returned. Also finish of surfaces and faces.

Chimneypieces.—If plain, they can be sufficiently described verbally, widths and thicknesses of jambs, lintels, and shelves, whether chamfered or moulded, finish of surface, how set, if cramps are of iron or other metal, whether solid or boxed. Or a provisional sum can be allowed, or detail drawings be given.

Granite.—Usually the best way is to obtain separate estimate from merchants, and include as provisional sum, stating if it includes carriage; if not, where it comes from. If specified in detail, give quarry, and, of course, all sizes, whether polished, or machine worked. Stipulate that it is to be free from slippers, iron stains, and metallic veins.

Marble.—Here, again, a separate estimate and provision is best. If this is not done, give sizes, description of kind, whether polished, and stipulate that stopping is not to be allowed. In some marbles this, however, is almost impossible to avoid. Veining and colour to be approved. Specify method of fixing. In marble paving, as in black and white squares, give the sizes of these, with the thickness, and especially stipulate for evenness of colour and close joints.

Tile Paving.—Usually specify a certain make or get separate estimate and include provision. Specify who is to lay, and if contractor, say how it is to be done, if jointed and laid in cement, also that surface is to be perfectly true

and level. If manufacturer lays it, stipulate for attendance and water to be provided by the contractor.

Mosaic Paving.—Usually best done by separate contractor at stipulated amount or p.c. sum per yard. Attendance as for tile fixer.

Wall Tiling and Mosaic.—These follow the same principles as described for paving.

Carving.—Allow provisional sum. State if contractor is to do boasting, and specify sizes, stones are to be left for carver. Provide for scaffolding and attendance and, if externally, for shelter and screens. Sometimes provision may be only for models, and contractor does carving. In all provisional sums for such work as described under this trade, and indeed for all provisional sums whatsoever, it is as well to state when the contractor is to pay, say within fourteen days after the architect has certified for payment, and reserving power to the employer to pay direct if contractor omits to pay within stipulated time, and that in this event the contractor shall not be entitled to any profit on the provisional sum or sums.

CHAPTER V.

TERRA-COTTA.

WITH buildings in which terra-cotta plays an important part, it is usual to make a sub-contract with a manufacturer for the supply of the material to the general contractor. Questions of colour, quality and punctual delivery make this desirable, if not absolutely essential. The amount of the sub-contract is usually arrived at by obtaining an estimate (with or without competition) based upon a bill of quantities supplied to the manufacturer. Unless there be very exceptional features in the work, this bill contains but few items, viz. :—

cubic feet plain and moulded terra-cotta.
cubic feet enriched do. do.
No. models.
No. enriched models.

It then becomes necessary to make the manufacturer and the builder jointly responsible for matters in which their respective duties overlap, and separately responsible for those things over which they have individual control. We, therefore, now proceed to give the separate forms of specification for manufacturer and builder; but, as many of the clauses are the same in both, the second specification gives merely a reference to those items of the first which it is desirable to repeat.

It may be mentioned that it is best for the manufacturer to receive *direct* payment upon certificate—the builder including in his own estimate his percentage upon the sub-contract to cover his liabilities in connexion with it.

Specification for the Terra-Cotta Manufacturer.

1. The terra-cotta to be delivered at the station in ton lots, complete and perfect, free of all charge for carriage and packing. All requisite information concerning, and marking upon the material, shall be supplied by

the manufacturer. It is to be of best quality, free from all cracks, and equal in every respect to samples deposited with the architect. These samples are to show the two allowable extremes of colour, and the extreme permissible deviation from true lines in mouldings and arrises—as well as the general finish of the enrichments. All pieces in any way inferior to these samples will be rejected, and new blocks in their place are to be supplied by the maker, who will not be entitled to any time allowance on this score for completion of either the whole work or of the sections into which it is divided in Clause 6 below. The terra-cotta to be in strict conformity with the drawings, models, and instructions supplied.

2. The setting out of the work to the necessary shrinkage scale, and all responsibility for its turning out of the exact sizes required for use are to be undertaken by the manufacturer.

3. But the builder may be called upon to supply particulars upon all points of setting out requiring attention, in order to meet the wants of other trades, and to assist in determining the numbers of the several pieces, and the identification marks to be put upon the various blocks.

4. The manufacturer to make and supply all the models that may be wanted. (In some cases, where the enrichments require more artistic treatment than the manufacturer would be able to give them, a special arrangement is made for this portion of the models to be supplied to the manufacturer). Such models as the architect may wish to see, are to be submitted to and approved of by him before being used for moulding from. Piece moulds to be made of the various blocks so that they may be moulded without stopping up the several parts with clay to the injury of the modelling. The clay to be pressed well home in the moulds, and when it is taken out the seams to be carefully obliterated. Each piece of terra-cotta is to be properly chambered and perforated, and to have such cross-webs, joggles on arch joints, &c., as will give it the requisite strength for its intended position in the building.

5. All joints to have chipping pieces and recesses or projections for joggling together.

Each piece must have the necessary cavities, fillets, channels, grooves, grooves for flashings, stubs, sinkings, joggles, dowel holes, mortices, perforations and recesses worked thereon to allow of proper bonding and connexion with adjoining work of whatsoever material it may be. All the blocks must be delivered perfectly accurate on every face, with the requisite chipping to the joints duly executed before delivery. No chipping, rubbing, or other interference with the fired surface of the material will be allowed to any exposed face.

6. The deliveries to begin weeks from the date of the order to proceed, and to be completed within months from such date, the whole being divided into sections as arranged between builder and manufacturer before the manufacture is begun. For any delay in the delivery of any section within the time so agreed upon, the manufacturer shall pay as liquidated damages 10 per cent. on the value of such section per month, after due allowance has been made for variations ordered, and for any strike or lock-out among the manufacturer's workmen.

7. Any terra-cotta damaged while the building is in progress by reason of defects in the manufacture, shall be replaced at the manufacturer's expense, or, if the architect so choose, the full value of such replacement shall be deducted from the contract amount.

8. The architect shall be free to alter the extent and character of the work by written order, but this shall not invalidate the contract. The value of such alterations shall be determined by the prices of the original estimate, a fully-priced copy of the quantities being deposited with the architect for that purpose.

9. Payments will be made from time to time on the architect's certificate to the extent of per cent. on the value of material delivered and approved in sums of not less than £ until the reserve amounts to £ . After that payments will be made in full and the balance of £ will be paid months after the whole work has been fixed in the building.

10. All the work intended to be level bedded shall, unless otherwise directed, range with a certain number of

brick courses, the number varying, as shown upon the detail drawings. In arranging the exact depth of the terra-cotta courses, a mortar joint of $\frac{3}{16}$ in. is to be allowed for.

The plain ashlaring to bed in alternate courses, or alternate pieces in each course, $4\frac{1}{2}$ in. and 9 in. on the wall, the blocks with 9 in. bed being chambered. The lengths of the several string blocks to average 12 in. with closers as wanted. In no case shall strings, cornices, &c., have a bed on the wall less than their projection from it. The window and door jambs and dressings generally to be very carefully bonded with each other and with the brickwork, the mouldings, where possible, being subdivided into two or more blocks in each course, breaking joint, moreover, with blocks above and below. The details of all such bonding, and the necessary variations of the blocks, will be arranged from the detail drawings by the builder and manufacturer.

11. The architect, clerk of works, and the builder shall have access to the manufactory at all reasonable times.

12. The prices to include manufacture, delivery, models, moulds, and all other works and expenses consequent upon the above conditions.

13. The cubic contents are arrived at by measuring all lengths net, and the heights and beds to $\frac{1}{2}$ in.

14. The dates and sums left blank to be filled in as may be arranged before the signing of the contract.

Builder's Specification in connection with the Terra-Cotta Work.

This specification should embody those clauses of the foregoing specification for the terra-cotta manufacturer numbered 1, 3, 5, 6, 10, 11, which need not here be repeated.

1. The builder shall give all such assistance to the manufacturer as may be necessary to secure the strongest and best construction, and that best adapted to the requirements of the material; and he shall be held responsible for the accuracy of all information supplied by him.

2. Any objection the contractor has to make to goods delivered must be made within one week of their arrival on the site.

3. The whole of the terra-cotta for as long as possible before fixing (and never for less than two hours) to be soaked in water. It is then to be filled up solid with cement concrete at a time when there is no frost. The concrete to be formed of one part by measure of Portland cement and six parts of finely broken stone and hard brick with an approved proportion of clean sand. The terra-cotta thus prepared is to be bonded to the utmost practicable extent with surrounding brickwork. The bricks to be well wetted and the whole flushed up.

Note.—Some authorities consider the use of Portland cement objectionable, as likely to lead to the fracture of the blocks by expansion of the concrete. It has however been used successfully in most important works. An alternative would be to fill in with a concrete composed of one part of finely ground blue Lias lime to five parts of the broken brick &c. Proper time for setting to be allowed before the terra-cotta blocks are placed in position,

4. By careful laying out and assortment in long lengths before fixing the utmost possible regularity and truth of line is to be secured in both horizontal and vertical members—special attention being given to the truth of the outer arris of the vertical mouldings.

5. Supply the necessary shores, stays, centreings, and supports with all requisite tile or deal protections and casings, making good any defects arising from the protection thus given.

6. Set in Portland cement the window-sills, strings, cornices, corbellings, mullions, transomes, copings, chimney-caps, and such like features. All other parts set in mortar as for the facings generally. Carefully wash down and clean at completion, and make good defective pointing.

7. The contractor must reject all unsuitable and defective terra-cotta. Any terra-cotta injured during the building's progress must either be replaced by the contractor, or, at the architect's option, have the full cost of such replacement deducted from the contract amount.

8. Work or cut all necessary grooves for lead flashings, and after wedging up the lead, point with cement. In the leaded gutter of main cornice, form or cut dovetail mortices

1 in. by 1 in. by 1¼ in. deep, about 12 in. apart. Clean up and carefully finish the terra-cotta against all door and window frames, and set out or cut all mortices for fixing purposes as described in other trades. The mortices for the lead plugs for fixing of iron casements are to be cut to correspond with the screw holes in the casements.

9. Put 3 in. by 1 in. by 1 in. slate dowels to mullions, balustrades, &c., and run same with cement. Put 1¼ in. by ⅜ in. copper cramps, 10 in. long, to joints of copings, knee blocks, balustrade cappings, and chimney caps, and run with cement. Put ⅝ in. by ⅝ in. copper dowels long to all finials.

10. The contractor is to receive the terra-cotta at the station, do all cartage to the site, unload, store, and protect it from all injury.

CHAPTER VI

SLATER

THE chief points in which specifications of this trade vary, and as to which the student should be careful, are the difference of custom in Welsh and Westmoreland slate supply and the selection of ridges. The production of Welsh slates being far greater than that of Westmoreland, it is customary to sell Welsh slates sorted to sizes (countess, duchess, &c.), but Westmoreland slates are more usually supplied in mixed sizes. If the architect, therefore, wishes the slating laid in diminishing courses from eaves to ridge, it must be specially mentioned in respect of Welsh slates, and, under ordinary circumstances, adds to the price, whereas the converse is the case with Westmoreland slates, with which diminishing courses may be taken as the normal method of supplying and laying.

Slate is a material which does not lend itself kindly to the formation of ridges and hips, still less of valleys, and, although we shall give an example of specifying such, it is more general nowadays to use tile or lead for these parts of the construction. With this explanation we may proceed.

Roofs.—Cover the roofs with best Bangor blue slates, "countess" size, of approved colour and quality, laid to 3 in. lap on 1½ in. by 1 in. sawn battens, and nailed with two sixpenny copper nails to each slate.

(If Westmoreland slates are to be used, say). Cover the roofs with Tilberthwaite (or other quarry) green slates, of approved colour and quality, laid in diminishing courses from eaves to ridge, with 3 in. lap on 1¼ in. rough boarding (or battens) and (giving name of maker) patent bituminous inodorous felt (or Willesden paper, 2 ply). The slating to be nailed with two 1¼ in. compo. nails to each slate.

(Whichever slate is used, add also). All eaves and

verges to have double courses; hips and ridges to be cut close.

Ridges.—Cover the ridges with 2½ in. rubbed slate bird's-mouthed roll and 6 in. by ½ in. sawn slate wings, all bedded and jointed in oil cement, and secured with brass screws.

(Or, in the alternative). Cover the ridges with red tile ridges, No. in list, p.c. per foot, set and pointed in cement. If green ridges—glazed or unglazed—are desired, it is well to say that they are to be purposely made by [giving the maker's name], at p.c. price of per foot, free on rail.)

Hips.—(These may be covered with slate roll and wings, in similar manner to that described for ridges, or with ridge tiles, but are more generally at the present time finished with close-cut slating and secret gutter, which may be thus described.) The hips to have the slating cut close to mitre line, with 5-lb. lead secret gutter 18 in. wide under same (or with 5-lb. lead soakers, 10 in. by 18 in., laid to bond in with courses of slating. Or a lead roll and wings may be used, but whatever is adopted should certainly be described under the heading of "slater," even though it may be plumber's work.)

Hip Finials.—Provide and fix at apex of hips, bedded and jointed in cement, red terra-cotta hip finials, as No. in the list of the Brick and Tile Company, p.c. each. (If the hip finials are to be in lead, mention it here.)

Valleys.—(Say whether the valleys are to be formed with soakers or with lead valley gutter, and describe).—The slating to be cut in true line to valleys with in. between edges of slating.

Verges.—The verges to be pointed (or set) in cement.

Stone Slates.—Cover the roofs with (Horsham, Collyweston, Stonesfield, or Forest of Dean) stone slates 1¼ in. thick, of approved quality, laid in diminishing courses from eaves to ridge, bedded in mortar and torched on the underside, each slate to have two oak pins hung over 2½ in. by 1½ in. battens (sometimes nailing is employed and sometimes the slates are simply bedded) to 3 in. lap. The ridges

to be bird's-mouthed plain ridges of stone (a freestone of durable character, sometimes Box ground or Doulting), 6 in. by 6 in. set, and jointed in blue lias lime mortar (not cement).

Slate Mason.

Cisterns.—(The use of slate cisterns is almost obsolete, but we give an example). The slate cistern in roof of scullery to be 6 ft. by 4 ft. and 3 ft. deep internal dimensions, with sides 1 in. thick and bottom 1½ in. thick, all in sawn Valentia slate slabs, put together with rebated and grooved joints in red lead and oil cement, the grooved slabs pointed externally with weathered cement filleting. Put round same two sets of wrought-iron straps, 1½ in. by ⅜ in., forged and screwed at ends with nuts and washers.

Sinks.—(These would be similarly described, but, of course, with smaller dimensions and thicknesses).

Shelves.—Fit up in larder two tiers of shelving, 9 in. wide at sides and 12 in wide at end. The shelves to be inch rubbed Valentia slate slabs, with rubbed and rounded edges, and rounded corners to 4 in. radius, and to be in one length each (or two, &c., if allowed), cut and pinned into walls 2 in. deep in cement. The shelves to be supported on wrought-iron brackets p.c. each plugged and screwed to walls, and secured to shelves with brass screws let in and bedded with oil cement (or mastic). [Or slate cantilevers can be used, which specify thus:—The shelves to be supported on 1½ in. rubbed (or sawn) diminished cantilevers, rounded on edge and at end, and to be the full width of shelving, 3 in. deep, and cut and pinned 4½ in. into wall in cement].

Urinals.—Form the urinals shown on plan with backs of ½ in. sawn Valentia slate slabs, bedded in mastic cement (or Portland), and secured with bronze cramps, cut and pinned into brickwork. The divisions to be of ¾ in. slabs grooved to backs, and secured with bronze (or brass) tuning-fork cramps 10 in. long, cut and pinned into wall, and screwed to slate with brass screws, nuts, and washers. Channel to be of 6 in. by 3 in. sawn slate dished to current, and set in cement flush with asphalte paving.

(The above are sufficient examples of the method of specifying for slate mason's work, any other special items being treated in a similar way.)

If enamelled slate is to be used, it is advisable to select a manufacturer in whom the architect can place confidence, and specify that make of goods at a p.c. price, inasmuch as the durability of the enamel depends entirely on the care taken in the manufacture, and the quality of the workmanship is very difficult to determine in the completed article without damaging it.

TILER.

Roofs.—Cover the roofs with hard, well-burnt, approved red tiles of local manufacture (or Broseley, Bridgwater, or other desired kind), entirely free from fire cracks and all other defects, laid to a 3½ in. gauge, with two stout cast-iron tile pins to each, and bedded in hay on 1½ in. by 1 in. deal battens, with proper tile and a half where required at edges to prevent the use of closers.

(This is the old-fashioned tiler's way of laying tiles, and has the approval of experience and of many good judges; but tiling is now often laid by bricklayers, and these craftsmen cannot get on without mortar, so, as an alternative, one may specify instead: The tiles to have their lower edges bedded in a small quantity of lime and hair and to be torched on the underside. Some architects bed their tiles wholly in mortar, but this method is more likely to hold the wet and keep the roof damp. Again, tiles are sometimes nailed, sometimes hung over the battens with nibs formed on the tiles, and even, though rarely at the present day, hung with wood pegs. This is a matter for the discretion or fancy of the architect. The specification should state which method is to be followed.)

All eaves and verges to have double courses, and to be pointed in cement. (This last stipulation is open to question.)

Ridges.—Cover all ridges with half-round ridge tiles set and pointed in cement (or specify a special make and pattern if desired).

Hips and Valleys.—Lay all valleys and cover all hips

with special valley and hip tiles to course and bond with roof tiling. (These are only kept in stock for mitres of roofs of the same pitch. If roofs of different pitch intersect at valleys or hips, the tiles would have to be purpose made. These tiles cannot, of course, be properly used where there is any curve in the slope of roof tiling, even if it be only the tilting of lower courses.)

Hip Finials.—(Specify as indicated under the heading of slater.)

Filleting.—(If this is to be used instead of flashings specify) :—At junction of tile roofs with vertical face of brickwork put stout cement filleting with nails and twine to hold same.

Vertical Tiling.—Cover the cheeks of dormers with vertical tiling of similar description to that used on roofs, nailed to 1¼ in. rough boarding with two compo nails to each tile, the courses to range with the courses of roof-tiling. (Describe whether the junction of vertical and roof-tiling is to have secret gutter or soakers.) The tiles to be cut close at junction of vertical and sloping faces. (If the whole of the upper story is tile hung, describe the way in which it is to be done, whether nailed to battens, plugged to wall, nailed to joints of brickwork, usually on edge, or bedded in lime and hair mortar.)

With both slate and tile-roofing the final clause should be—

Completion.—Clean out gutters, replace any cracked or broken tiles (or slates), make good any defective pointing or filleting, and leave the roofs clean, perfect, and weather-tight at completion.

CHAPTER VII.

CARPENTER.

IN specifying the materials for this trade, the architect should make up his mind definitely as to the precise grade of quality which he desires, and then define that grade clearly and insist upon its being supplied. To do this requires a good knowledge of the timber market, and of the current prices and supply. The marks on timber are constantly changing, and the quality of the various classifications of different shippers is widely divergent, hence the knowledge required to accurately specify the quality of timber needs constantly to be revised and brought up to date. We give examples of various methods of specifying timber.

Materials.—The whole of the fir timber is to be of the best Memel, Dantzig, or Riga. The deals to be the best quality seasoned Christiania. The timbers and deals are to be cut die square, entirely free from sapwood, shakes, large, loose, or dead knots, and all other defects.

(This is the oldest fashioned form now in use, and, in spite of its apparent stringency, is in reality delightfully vague. The term "best" has no real significance. The quality of Memel, Dantzig, and Riga timber is not equal, nor are these the only ports from which high-class timber can be obtained; whilst Christiania may almost be said to be the one port from which the deals for any particular work will most likely not come.) As another example of a clause not intended to be unduly strict, but meant to imply average quality, we have the following:—

Materials.—The timber for carpenter's work to be good quality yellow fir timber from Baltic ports, cut out of baulk where necessary, but in other cases converted from boards, free from sap, large or loose knots, shakes and other defects, all to be well seasoned and sawn die square, and to hold

the specified scantlings when finished. No outside slabs or sapwood to be used, and no pitch pine or other American timber to be used for carpentry without special permission from the architect. (If the architect wishes the scantlings, figured or specified, of his woodwork to hold full when finished it is necessary to state it, as the custom of the trade, both of carpenter and joiner, is to allow for waste in working. There are many advantages in using converted timber rather than cutting from baulk, chief amongst which are better seasoning, and as a general rule better quality. In spite of the increased labour of working, pitch pine is, for reasons sufficiently obvious, greatly in favour with present day builders in preference to Baltic fir, and its use should therefore be guarded, as discretion is required.)

Again, as a further example we may specify thus, bearing in mind that practically there are four qualities of fir timber, viz., "Crown," "best middling," "good middling," and "common middling," and that boards have "Crown" and "Crown brack" as superior though little used qualities to 1st, 2nd, 3rd, 4th, and 5th quality.

Materials.—The timber for carpenter's work to be Crown Memel or other approved fir of equal quality where cut from baulk, and of a quality equal to Petersburg 1st where cut from deals. (The architect will, of course, use his own discretion as to the selection of the quality or brand that is to form the criterion of excellence. Crown Memel, for example, is far superior to the timber generally employed in building.) Having settled the question of quality, the specification will proceed, as follows:—

Distances Apart.—No joists, rafters, or quarters to be fixed more than 12 in. apart in the clear, and all to be properly trimmed for fireplaces, chimneys, &c. The trimmers and trimming rafters and joists to be in all cases ½ in. thicker than the ordinary timbers. (In some cases it may be desirable to still further increase the thickness of trimmers. Where this is so, the particular instances should be mentioned, as the clause given will apply generally.)

*Lintels.**—Put lintels where required to internal openings

* There is a fashion, now coming up, for spelling this "lintols," but there is not the slightest orthographical authority for it. "Lintels" is the correct spelling.

of all plastered rooms, 1 in. in depth for every foot of span, the full width of reveals and 12 in. longer than the respective openings, but in no case less than 3 in. deep.

Centres, &c.—Supply all requisite centering for arches, turning pieces, springers, templates, &c., the trimmer arches to be firred down and filleted (or centres left in) to receive lathing, and no centre to be struck until sanctioned by the architect. Supply and fix all necessary bracketing and cradling.

Fixing for Joinery.—Insert in jambs of all openings to be fitted with joinery wood slips, $\frac{3}{8}$ in. thick, $4\frac{1}{2}$ in. wide, and in length the full width of opening, built into and securely fixed in the joints of brickwork. (If wood bricks or breeze concrete fixing blocks are preferred, specify accordingly.)

Bressummers and Binders.—The bressummers over to be formed of No. 4 9-in. by 3-in. deals, bolted together with $\frac{3}{4}$-in. wrought-iron bolts with heads, nuts and washers, No. 6 to each bressummer. The bressummers to be 18 in. longer than opening, and to have 3-in. tooled Yorkshire stone templates, 14 in. by 14 in. under ends. The binders to be 6 in. by 4 in. and 12 in. longer than span, and to rest on 3-in. tooled Yorkshire stone templates, 9 in. by 9 in.

Floor Joists.—The timber floors to be formed with joists of the following scantlings, all to be properly notched and spiked to $4\frac{1}{2}$-in. by 3-in. plates, which are not to be built into walls, but carried on corbelling of two oversailing brick courses where plaster cornices allow, and elsewhere on wrought-iron corbels, weight 7 lbs. each, built into walls every 3 ft. apart.

Joists to ground-floor rooms, $5\frac{1}{2}$ in. by 3 in. Joists to first floor rooms over scullery, larder, pantry, and servants' corridor to be 7 in. by $2\frac{1}{2}$ in., over remainder of ground floor 9 in. by 3 in.

Herringbone Strutting.—All floors of first floor to have herringbone strutting $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in., not more than 6 ft. apart.

Sound Boarding.—Put between joists of floors over

reception-rooms, ½-in. sound boarding on 1½-in. by 1-in. fillets, and lay pugging, 2 in. thick, of chopped hay and lime, in proportion of 4 to 1, laid dry.

Roofs.—(If the roofs are fully and clearly shown on the drawings, it may be sufficient to say:) The roofs of buildings and the trusses to same to be framed up, as shown upon drawings, with timbers of the sizes figured thereon. The rafters to be notched down upon purlins and plates, cut true at the ridges, and securely spiked thereto. (Or the particulars may be given thus:) The roof over offices to have three king-post trusses, with tie beams 9 in. by 4 in.; principal rafters 6 in. by 4 in.; struts 4 in. by 4 in., and 1-in. circular wrought-iron king-rod, with wrought-iron plate at head, 18 in. long by 4 in. wide, and ½ in. thick, forged to shape, and bolted with No. 2 ½-in. bolts to principals. Put inch wrought-iron bolts, 18 in. long, fixed solid through tie-beams and feet of principal rafters. Purlins to be 6 in. by 4 in.; ridges, 9 in. by 2 in.; common rafters, 4½ in. by 2½ in.; hips and vallies, 7 in. by 3 in.; plates, 4½ in. by 3 in. The main roof to have four king-post trusses with tie beams 10 in. by 4½ in.; principal rafters 7 in. by 4½ in.; struts 4½ in. by 4½ in.; and 1¼-in. circular wrought-iron king-rod with wrought-iron plate at head, 20 in. long by 4½ in. wide and ⅝ in. thick, forged to shape, and bolted with No. 2 ⅝-in. bolts to principals. Put 1¼-in. wrought-iron bolts 20 in. long, fixed solid through tie-beams and feet of principal rafters. Purlins to be 7 in. by 4½ in.; ridges, 9 in. by 2 in.; common rafters, 5 in. by 3 in.; hips and vallies, 7 in. by 3 in.; plates, 4½ in. by 3 in.

Boarding and Battening.—Cover main roof with inch rough boarding and ———'s bituminous, inodorous felt, lapped 2½ in. at edges, and nailed to boarding with zinc or compo clout nails. Lay over the roof to offices 1½-in. by 1-in. battening, set out to 3½-in. gauge for tiling (or to the proper gauge for slating).

Flat.—The flat over porch to have 5½-in. by 2½-in. joists, 4-in. by 3-in. plates, and to be laid with 1¼-in. deal traversed boarding edges shot for lead, laid to fall with the necessary firrings. Put 2-in. rounded deal rolls for lead, 3 ft. centre to centre.

Gutters.—Lay the gutters with 1¼-in. gutter boards and framed bearers to a fall of 1½ in. in 10 ft., with 2½-in. cross rebated drips 9 ft. apart. The gutters to be 9 in. wide at the narrowest part. Form deal dovetailed cesspools, 8 in. by 8 in., and 6 in. deep, for outlet of gutters, with proper dished and rebated perforation for 4-in. pipe.

Snow Gratings.—Lay over all gutters deal wrought snow gratings of 2-in. by 1½-in. battens, about 1 in. apart, on 4-in. by 2-in. cut and shaped bearers, about 3 ft. apart. These gratings to be made in 6-ft. lengths for easy removal, and to be put together in white lead and pinned with oak pins and creosoted.

Lier Boards and Tilting Fillets.—Put ¾-in. by 7-in. lier boards at sides of gutters and vallies and along slopes of roofs adjoining vertical faces and deal tilting fillets 1½ in. by 1 in. To all eaves put tilting fillets 3½ in. by 1½ in.

Eaves.—Put ¾-in. by 7-in. wrought and beaded fascia to eaves (or instead the treatment of eaves may be specified thus) : The feet of rafters to project 12 in. from face of wall, and to be wrought and the ends shaped to detail with wrought sprocket pieces 18 in. long by 3½ in. wide and the full thickness of rafters. (If the under side of eaves is boarded specify it; if to be plastered say.) Put under eaves on feet of rafters and also plugged to wall, 1½ in. by 1½ in. fillet to receive lathing.

Half-timbering.—The half-timbering to be of well-seasoned fir, with 7-in. by 4½-in. posts and beams out of 11 in. by 6 in., and heads 4½ in. by 4½ in., left as from the saw, put together in white lead and pinned with 1½-in. oak trenails left projecting ½ in. from face of timbering. This half-timber work is to be cut out immediately after signing of the contract, and to be properly creosoted to absorb 10 lb. weight of creosote per cubic foot. The contractor is to arrange for the weighing of the worked timber in the presence of the architect, before it is despatched to the creosoting works, and also on its return before fixing.

Barge-boards.—The barge-boards to be 2-in. wrought and cross-tongued yellow deal 15 in. wide on main roof, and 12 in. wide on roof of offices, all to be moulded on lower edge, and to have 4½-in. by 2-in. moulding planted on to

the other. (If moulding is returned at foot, say so. Also specify apex finials if desired.) The barge-boards to be mitred and cross-tongued at apex.

Quarter Partitions.—Frame the quarter partitions on first floor with heads, sills and braces, 4½ in. by 3 in.; posts, 4½ in. by 4 in.; quarters and puncheons, 4½ in. by 2½ in.

The trussed partition over drawing-room to be framed with queen-post truss as sketch (give sketch in margin showing in single line the timbers forming the truss), with tie beam 7 in. by 4½ in., and the remaining timbers shown in sketch, 4½ in. by 4 in. Put 1½-in. by ¼-in. wrought iron straps 30 in. long to feet and 24 in. long to heads of queen-posts, with gibs and cotters, and ¾-in. bolts 14 in. long, with head, nut and washer to feet of principals, fixed solid through tie beam.

Ceiling Joists. — Put 4½-in. by 2-in. ceiling joists over bedrooms on first floor.

Trap Doors.—Trim for trap doors where indicated on plans; one over bedroom corridor 2 ft. 6 in. by 2 ft., and one on roof 2 ft. 9 in. by 2 ft. 3 in.

Cupola roof.—Construct the octagonal roof of cupola over vestibule, as shown on detail drawing, with principal ribs at angles 7 in. by 2½ in., intermediate ribs, 5½ in. by 2½ in. These ribs to be firred up to curve with stuff of 2½ in. thickness, spiked on. The principal ribs to be bolted to curb 6 in. by 4½ in., with ¾-in. wrought-iron bolts. Posts of lantern to be 6 in. by 4½ in., wrought and worked to sunk faces. Head and braces 4½ in. by 4½ in. Rafters 4½ in. by 2 in. Finial out of 4½ in. by 4½ in. turned and moulded, and with turned ring out of 2 in., cross-tongued, and fitted to finial. Head to be scarfed at angles, and bolted to posts with 8-in. coach screws. Balusters to be out of 2½ in. by 2½ in., turned and moulded, and spandrils out of 2½ in., wrought, cross-tongued, shaped, and moulded on lower edge and framed to posts and heads with oak dowels to balusters. Sashes to lantern to be 1¾-in. ovolo moulded fixed sashes, with shaped heads. Ceiling joists under cupola to be 4½ in. by 2 in.; plates, 4½ in. by 3 in. Put 1¼-in. wrought and cross-tongued apron lining with moulded condensation

gutter out of $4\frac{1}{4}$ in. by 2 in. The moulded cornice above sashes of lantern to be out of 7 in. by $1\frac{3}{4}$ in., bracketed, and screwed to framing.

Dormers.—The dormers on main roof to be formed with front of $4\frac{1}{2}$-in. by $4\frac{1}{2}$-in. wrought, rebated, and twice moulded posts, $4\frac{1}{2}$-in. by 4-in. wrought, rebated, and moulded head, 6-in. by 4-in. oak sunk, weathered, rebated, and throated sill. These dormers to have rafters $3\frac{1}{2}$ in. by 2 in., plates 3 in. by 3 in., ceiling joists $3\frac{1}{2}$ in. by 2 in., ridges $5\frac{1}{2}$ in. by 2 in., hips and vallies 7 in. by 2 in., cheeks to be framed with studs 3 in. by 2 in. The roof and cheeks of dormers to be covered with inch rough boarding and felt, as described to main roof. The eaves to be (describe according to the plan adopted for main roof, see p. 43 *ante*), and to have deal moulded cornice out of $4\frac{1}{2}$ in. by 2 in., mitred at angles and screwed to framing. The casements to be 2-in. ovolo moulded with sash-bars $1\frac{1}{4}$ in. wide, hung with 3-in. wrought-iron butts, to open outwards, and to have 12-in. japanned iron casement stay-bar with stub-plates and japanned iron cockspur fastening. Edges of casement and sides of frame to be throated to form water-stop. Bottom rail of casement to be splayed, rebated, and throated. Finish inside with $1\frac{1}{4}$-in. by 3-in. moulded architrave, and $1\frac{1}{4}$-in. rounded window board 6 in. wide, tongued to oak sill. Window back to be formed with $3\frac{1}{2}$-in. by 2-in. ashlaring for plastering.

Verandah.—Construct the verandah as shown on detail drawing, with all visible and exposed woodwork of carefully selected Riga fir of "best middling" quality, wrought with a clean finished surface. Posts to be 5 in. by 5 in., with 4-in. by $1\frac{1}{2}$-in. moulding planted on, and $\frac{3}{4}$-in. by 7-in chamfered plinth. Heads to be 5 in. by 4 in., and the curved filling pieces to be 2 in. thick, cross-tongued, cut to shape, and moulded on edge. The posts to have 5-lb. lead seatings and dowels of inch wrought-iron barrel, 4 in. long, mortised into posts and stone bases. The roof over verandah to be constructed with $4\frac{1}{2}$-in. by 2-in. rafters, $1\frac{1}{2}$-in. pitching piece, $5\frac{1}{2}$-in. by 3-in. hips, and to be covered with $1\frac{1}{2}$-in. by 1-in. battening, set out to $3\frac{1}{2}$-in. gauge for tiling. The eaves to have sprocket pieces out of 18 in.

by 3 in., and feet of rafters to be cut to shape, as shown on detail drawing.

Fencing and Gates.—Put at back of site open pale fencing, 4 ft. 6 in. high from ground, with oak posts 9 ft. apart, one pair of fir arris rails out of 3½-in. by 3½-in. and 3-in. by 1-in. sawn deal pales, 2¼ in. apart with pointed ends, and to stand 2 in. clear of ground at bottom. The oak posts to be cut out of trees not less than 9 in. diameter, the parts below ground to be left full size and charred, and every third post to be set in concrete block at least 6 in. wider each side than heel of post. The remaining posts to be well rammed. The fencing and posts to be twice tarred with Stockholm tar at completion.

Put at sides of site oak pale fencing 5 ft. 6 in. high, with 6-in. by 4-in. posts, two arris rails out of 4½-in. by 4½-in. and gravel board 9 in. by 1½ in., filled in with cleft oak pales, lapped and nailed to rails. The feet of posts to be well tarred in gas tar before fixing.

(N.B.—Alternative treatment of feet of posts is specified in this and the preceding clause for the sake of example. With oak posts the first method is generally preferable.)

Put to openings in 2½-in. framed, ledged, and braced oak dwarf open gates with cut and moulded horns to stiles put together with white lead, and pinned with oak trenails. The gates to be hung with a pair of purpose-made wrought-iron strap hinges 24 in. long, with ornamental heads to detail to 5-in. by 5-in. wrought and rebated posts with turned and moulded finials out of 6 in. by 6 in. and 15 in. long dowelled to posts. Each gate to have strong wrought-iron purpose-made gate latch to detail.

Summer House.—Construct the rustic summer house, as shown on drawings, with oak sill, 6 in. by 4 in. laid on 6-in. bed of cement concrete, sides constructed of larch saplings, average 3 in. diameter, halved, where shown on drawings to cross each other, put together in white lead, and pinned with oak trenails. The roof to have 4½-in. by 2-in. rafters, 4½-in. by 2-in. collars dovetailed and spiked to rafters, 9-in by 2-in. ridge and hips, and 4-in. by 3-in. plate. Under side of rafters and collars to be lined with inch matched and V-jointed boarding in half-batten widths. The roof to

be covered with thatching of oaten straw, 18 in. thick, properly tied and secured. Put around sides of summer-house, internally, 1½-in. elm seat with 2-in. shaped elm brackets and inch elm skirting-board around. Provide for flooring, lattice grating of 1½-in. by 1-in. teak battens, halved and pinned with 1½-in. meshes, and formed in sections about 6 ft. superficial each, as shown on plan, and to have framed and curved teak bearers 1½ in. thick under edges of each section.

There are, of course, many other structures, which come within the carpenter's province in special cases, which must be dealt with separately, but the specimens already given should serve as a sufficient guide to the student.

CHAPTER VIII.

JOINER.

IN this case, as with the carpenter, the precise determination of the quality of wood required is the first consideration, and the student will, of course, bear in mind that it does not necessarily follow that the deals and fir timber from the same port are of equal quality or equally suitable for the different work of the carpenter and the joiner. Thus, whilst crown Memel may be taken as representing the highest quality of fir timber for carpentry work, Onega and Archangel deals are about the best suited for joinery.

Materials.—The deals to be of———(state that desired) quality yellow or red deals, from (Russian) ports, but for panels only of internal doors and framing, American red or yellow pine of approved quality may be used. (This is, of course, a matter for the architect's discretion. If there is no objection to American wood, it should be thus stated in the specification.) All deal and pine to be perfectly sound and well seasoned, cut out perfectly free from sapwood, large, loose, or decayed knots and other defects.

The fir for casement and door frames and other joiner's work to be cut out of——(state that desired) quality red or yellow fir of bright colour and straight grain, and free from knots.

(If the work is practically entirely in deal, the oak for sills and the small amount of other hard wood required, as mahogany for water-closet seats, can have their quality stipulated under this section, but if there is a considerable amount and variety of, say, wainscot or other special wood, it is as well to make a separate heading, and write the description of all work in that wood together.)

The oak for sills and thresholds to be sound, well grown, and properly seasoned oak of English growth.

Workmanship.—All joiner's work to be wrought and

finished according to the detail drawings, with a clean, even, and smooth surface from the plane, and no sand paper is to be used.

The dimensions and thicknesses of joiners' work, figured on the drawings or described in this specification, are the original ones out of which the joinery is prepared, and not the finished thicknesses after planing and cleaning down. (This being the usual practice of joiners, it is as well to adhere to it and save confusion. It is often specified that the sizes are to be finished sizes when fixed; but bearing in mind the way in which joinery is prepared, legitimately, from deals, it is really irrational to expect that finished sizes shall be exact in inches. The finished thicknesses should be stated in sixteenths of an inch, as a "$1\frac{13}{16}$-inch door," and so on.)

All glued joints to be feather-tongued, and the glue to be a mixture of equal parts Scotch and French glue, used fresh. External work to be put together in white lead.

The joiners' work is to be put together without wedging, and placed in a hot-stove room for at least one month before finishing, and any which may split, shrink, part in the joints, or show flaws or other defects, is to be removed and replaced with new material.

The floors, after being laid, are to be protected with a thick covering of dry sawdust until completion, and treads of stairs to be protected with rough cover boards.

Floors.—The floors of to be laid with $1\frac{1}{4}$-in. yellow deal flooring in half-batten widths, grooved and tongued with rebated heading joints, and mitred borders to hearths. These floors to be secret nailed.

The floors of to be laid with inch yellow batten flooring, ploughed and tongued with hoop iron, with splayed heading joints, and mitred borders to slabs.

The floors of to be laid with inch yellow deal straight joint flooring, with splayed heading joints, and to be covered with inch parquet flooring, to be supplied and laid by Messrs. , at p.c. price of per yard super (or quote the amount in lump sum), to be paid to Messrs. by the contractor within one month after presentation of the architect's certificate.

The floor of to be laid with mill-traversed yellow deal boarding, inch thick, laid straight joint, with butted heading joints.

Skirtings.—All skirtings to be tongued to floors, and to have tongued and mitred angles.

Put to 1¾-in. double faced and fully moulded skirtings, 15 in. high, on splayed grounds and backings.

The skirtings in to be 1½-in. moulded skirting, 9 in. high.

The skirtings in to be 1-in. by 7-in. square skirting.

Put 2-in. by 2-in. rounded fillet as skirting to floor of kitchen.

Windows.—The windows numbered on plans to have deal cased frames, oak sunk, weathered, and check-throated sills, and 2-in. double hung ovolo moulded sashes with sash bars 1¼ in. wide. Deal cased frames to have 1¼-in. pulley stiles, and 1-in. inside and outside linings, and ¾-in back linings, all tongued together, and the parting beads tongued to frame. All oak sills to be grooved on underside, and to have 1½-in. by $\frac{3}{16}$-in. galvanised iron water bar bedded in whitelead, and let into groove in stone sill (or brick). Sashes to be double hung with brass bushed axle pulleys, braided cotton lines, and iron weights. All double hung sashes to have strong knife-proof brass sash-fasteners (a special make or patent may be stated), each lower sash to have a pair of brass sash-lifts, p.c. each, and each upper sash to have a pair of brass sash-pulls, p.c. each. All double hung sashes to have moulded horns, and in place of usual bottom bead a beaded sill piece 4½ in. by 1 in.

The windows numbered on plans to have double hung sashes as above described, but with 6-in. by 3-in. rebated, weathered, and throated transome, and 2-in. fanlight above same to match sashes in detail, and to be hung at bottom with a pair of 3-in. brass butts. These fanlights to be rebated on bottom rail, and to have externally a moulded and throated weather fillet out of 2½ in. by 2½ in. tongued on to rail. Fit the fanlights with wrought-iron quadrant stay-bar, with lines and pulleys to open and close

fanlight from floor. (In every case the student may be advised to fix a p.c. price for each item of ironmongery, and to select his ironmongery at that price. But let it be quite clear, as enforced in an earlier chapter, what p.c. means, as ironmongery is pre-eminently a discount trade).

The windows numbered on plans to have 4½-in. by 4-in. rebated and twice-moulded casement frame, with 6-in. by 3½-in. oak, rebated, sunk weathered and throated sills, and to have 2-in. ovolo moulded sashes with sash-bars 1¼ in. wide. These casements to be hung with a pair of 4-in. brass butts to open outwards, and to have 12-in. brass casement stay-bars with stout plates and strong brass cockspur fastening (p.c.).

The windows numbered on plans to have similar frames and casements, but these are to be fixed.

The windows numbered on plans to have 4½-in. by 4-in. fir rebated, chamfered, and moulded frames, with 6-in. by 3½-in. oak, rebated, sunk, weathered and throated sills, and to be fitted with 2-in. ovolo moulded sashes, the lower part fixed and the upper hung on butts as fanlight, in a similar manner to those windows numbered

The bull's-eye windows numbered on plans to have 4½-in. by 4-in. fir rebated, chamfered and moulded frame, put together in two thicknesses and keyed with oak hammer-headed keys, and to be hung with 2-in. ovolo moulded casements on brass sash centres and fitted with white cotton cords in one length and brass screw-eyes in sash to open and close same, and brass cleat to fix same (quote p.c).

Linings to Windows.—All linings to be tongued to frames, and to have tongued and mitred angles. The windows numbered on plans to have 1¼-in. framed, moulded, and panelled linings and soffits, on deal dovetailed backings. The architrave moulding around to be out of 4½ in. by 1½ in. with wrought, moulded, and splayed ground 7 in. wide. The window board to these windows to be 1¼ in. rounded with moulding out of 3½ in. by 1½ in. below same. These windows to have 1¼-in. moulded, panelled window backs and elbows.

The windows numbered on plans to have 1¼-in. plain jamb linings and soffits, ovolo moulded on edge, 5½-in.

by 1½-in. moulded architraves on 1-in. splayed grounds, and 1¼-in. rounded window boards. No window backs to these windows.

The windows numbered on plans to have no window linings or architraves, the plaster being continued over jambs, but they are to have 1-in. rounded window boards with returned nosings.

(N.B.—If the linings correspond exactly with the classes of windows, it is well to let the description of linings follow immediately that of the windows to which they apply, but it would usually happen where there is a considerable variety of windows as indicated in the description given above, that one class of linings would apply to more than one kind of window. In this case it is better to specify all the window-linings together after the model given above).

Doors.—All door frames on stone thresholds to be dowelled with 1-in. wrought-iron dowels, 3 in. long.

The doors, numbered on plans to be 2¼-in. folding-doors, each leaf four panelled, the top and bottom panels to have raised panels, and all to be moulded both sides. The frame to be 4½ in. by 4 in., rebated, chamfered, and moulded, and the doors to be hung thereto with one and a half pairs of 4-in. wrought-iron butts to each leaf. Put a pair of 9-in. wrought-iron barrel-bolts and street-door latch, p.c. 25s., to these doors, and a pair of bronzed-iron door-knobs, p.c. 10s. each. These doors to have 6-in. by 2½-in. architrave moulding, splayed at back for plaster. The pedimented over-door to be out of 2-in. stuff with moulded scrolls, as shown on detailed drawing.

The doors, numbered on plans, to be similar, but the frame to have twice rebated and twice moulded transome, 4½ in. by 4 in. and 2-in. ovolo moulded fixed fanlight over. Put to these doors 8-in. rebated mortice-locks (p.c.) with brass furniture both sides and two keys. These doors to have 4½-in. by 2-in. splayed architrave moulding both sides.

The doors, numbered on plans to be framed, ledged, and braced with 1½-in. framing, covered with 1-in. V-jointed boarding in half batten widths, and hung with a pair of 4-in. wrought-iron butts to 4½-in. by 4-in. rebated

and chamfered frames, and to be fitted with 7-in. rounded rim dead lock (p.c.) and a pair of 9-in. wrought-iron barrel bolts.

The doors, numbered on plans, to be 2-in. five-panel doors, moulded both sides, hung with a pair of 4-in. wrought-iron butts to 1½-in. rebated and beaded jamb-linings with architrave mouldings out of 4½ in. by 2 in. These doors to be fitted with 6-in. 2-bolt lever mortice locks with brass furniture both sides (p.c.).

The doors, numbered on plans, to be 2¼-in. folding-doors, each leaf in three panels, ovolo moulded both sides with slamming stiles, rebated and beaded. The upper panel in each leaf to be open, and prepared for plate glass with mitred shifting beads secured with brass cups and screws. These doors to have 4½-in. by 4-in. chamfered and rebated frame, chamfered and twice rebated transome, and 2-in. ovolo moulded fixed fanlight. The doors to be hung with a pair of 4-in. wrought-iron butts to each leaf. Put brass handles, lettered "Pull," p.c. 10s. each, and short helical door-springs on one side, and brass finger-plates, p.c. 7s. 6d. each, on the other. No lock to these doors.

The doors, numbered on plans, to be 2¼-in. swing-doors, each leaf in five panels, moulded both sides, with properly rounded heels to stiles. The middle panel in each leaf to be open and prepared for plate glass, with mitred shifting beads, secured with brass cups and screws. These doors to have 6-in. by 4-in. moulded frame, hollow grooved for heel of door. The doors to be hung with spring hinges, p.c. 30s. each, let into boxing framed to floor joists. Put bronzed pull handles, p.c. 15s. each, one pair on each side of doors.

The doors, numbered on plans, to be 2 ft. 8 in. by 6 ft. 9 in., 2-in. five-panel doors, moulded both sides, hung with a pair of 4-in. wrought-iron butts, and to have 6-in. two-bolt mortice locks and brass furniture, p.c. 7s. 6d. each. The linings to be 1½-in. double rebated linings on wrought, splayed, and beaded grounds, and architrave mouldings out of 4½ in. by 2 in., with blocks the full height of skirting out of 5 in. by 2¼ in., shaped to suit architraves.

Stairs.—The stairs to have 1¼-in. treads, with rounded nosings and inch risers glued, blocked, and bracketed on 3½-in. by 2-in. fir carriages, 1½-in. moulded outer string, 1¼-in. moulded wall string, inch beaded apron linings, curtail step and veneered riser, newels turned and moulded out of 3½-in. by 3½-in. selected Riga wainscot, moulded handrail out of 3-in. by 4-in. selected Riga wainscot, 1½-in. deal turned balusters housed to string and handrail. The newels to be brought below landings, and turned as pendants 6 in. long. The wainscot to be twice oiled with olive oil at completion.

Fireproof Stairs.—The stair to be constructed as shown on detail drawing, with rolled steel joists, which will be supplied by Messrs. at the p.c. sum of £ , cut to sizes and delivered on the works. The contractor to put work together, and form stair in concrete of Portland cement and coke breeze in proportion of 1 to 6. This stair to have inch teak treads, with 2-in. teak rounded nosings tongued to same, and secured with stout brass screws to plugs let into concrete, glazed brown tile risers, soffits and ends of steps rendered and set in Keene's cement. The newels to be turned and moulded out of 4½-in. by 4½-in. teak, balusters turned and moulded 2-in. deal, handrail moulded out of 3½-in. by 2½-in. teak. The teak to be left clean from the plane, and not oiled or varnished.

Skylights.—The skylights over to be 2-in. chamfered bar skylights, 4 ft. 6 in. by 2 ft. 6 in., weathered and throated for condensation, fixed to 1¼-in. wrought, rebated, and staff-beaded curbs. Put lead gutter behind skylight, with 1-in. gutter boards and framed bearers.

Trap Doors.—The trap doors over to be 2 ft. 6 in. by 2 ft. in clear with traps of ¾ in., matched and V-jointed boarding, with two 3½-in. by 1¼-in. ledges, fitted and hung with a pair of 3-in. wrought-iron butts to inch rebated and staff-beaded curb linings tongued at angles.

Step-ladders.—The step-ladder, shown on plan of , to be formed of 4½-in. by 2-in. treads, with rounded nosings, housed and tenoned to a pair of 9-in. by 3-in. sides. Under top, middle, and bottom treads put ½-in. wrought-

iron tension bolt with head, nut, and washer. Put 2½-in. deal mop-stick handrail, with 3-in. by 3-in. posts at each end, halved and bolted to sides.

Casings.—The steel girders over to be cased with 1¼-in. cross-tongued casing, grooved and tongued and staff-beaded at angles, and fixed to girders with 3-in. by 2-in. blockings, 18 in. apart, bolted through webs of girders with $\frac{3}{16}$-in. bolts. The cornice moulding to be out of 7 in. by 3 in., screwed up to casing and joists.

Put inch beaded pipe-casings on rebated and beaded grounds to all exposed pipes, and fix same with brass cups and screws to remove easily.

Shelving.—Provide, to be fixed where directed, 100 ft. super. of inch wrought cross-tongued shelving with 1½-in. by 1-in. bearers, and wrought-steel brackets.

Fix where directed in store-room 100 ft. super. of open lattice shelving, 2 ft. 6 in. wide, of 1½-in. by 1¼-in. battens, 3 in. apart, halved and pinned, and 1½-in. by 2½-in. bearers 2 ft. apart, carried by 2½-in. by 2½-in. framed posts.

Dresser.—Supply and fix, where shown on plan, in kitchen, a deal dresser, 6 ft. wide by 7 ft. 6 in. high, with 1¼-in. sides and centre division, ¾-in. top on 3½-in. by 1-in. rails framed to sides and centre, with moulded cornice out of 3½ in. by 2 in., three tiers of inch shelves, 5½ in. wide, grooved for plates, and with three dozen brass cup-hooks, slab of 2-in. white deal, cross tongued and in two thicknesses pegged together, three drawers 7 in. deep inside with 1½-in. fronts, ¾-in. sides, lap dovetailed to front and dovetailed to ¾-in. backs, and grooved and tongued to ¾-in. bottoms, bearers for drawers 3½ in. by 1 in., turned oak drawer-handles out of 3 in. by 3 in., 1¼-in. cupboard front below drawers in two cupboards, each with a pair of doors, hung folding, with rebated and beaded stiles, 1¼-in. pot board on 3½-in. by 2-in. bearers, shelf in cupboards 18 in. wide, of inch deal cross-tongued. The cupboard doors to be hung on 3-in. wrought-iron butts, and to be fitted with 4-in. cut cupboard locks, and 4-in. neck bolts.

Water-closet Fittings.—Fit up the water-closet on first floor in Honduras mahogany, stained and French polished, with 1-in. cross-tongued seat and riser, 1-in mitre clamped

and cross-tongued flap, with rounded nosing and thumb moulding tongued on, hung with 3-in. brass butts to frame, and with ¾-in. by 5-in. beaded skirting around. The whole to be put together with brass cups and screws to remove easily, and fixed on strong deal bracketing. Seat hole to be cut and dished. Handle hole to be cut and beaded. Supply and fix quadrant-shaped Honduras mahogany paper box, 9-in. radius of ¼-in. stuff, with door hung on 1½-in. brass butts, and fitted with solid brass turn-buckle fastening. The servants' water-closet to have similar fittings, but in yellow deal, picked for staining, except the seat, which is to be in clean willow.

(The above is for the framed water-closet seats which have long been the accepted method of fitting these apartments; and which some persons seem still to prefer, probably from an idea that they are neater and more decorous looking than the pedestal closet; but they leave a hidden, empty space which gradually gets full of dust and dirt. Pedestal closets, which are on every ground preferable, are often supplied with seats by the maker. If so, this should be mentioned; if not, the joiner's work for them will include what is given above with the omission of "riser" and "handle-hole," and skirting will be "at back" instead of "around." If anything else, different from the usual type, is required, it should be mentioned.)

Bathroom Fittings.—Fit up bath with stained and French-polished 1¼-in. Honduras mahogany top, cross-tongued, and with dished perforation and rounded nosing. The enclosure to be 1¼-in. deal panelled and moulded framing, made to remove easily in sections, and fixed with brass cups and screws. Supply and fix cradling for bath of 3½-in. by 2-in. stuff, and assist plumber in fixing.

(The same saving clause applies to the bath-framing as to the water-closet. If people will have bath-framings, they have to be specified; but they are much better dispensed with.)

Fit up towel-rack on wall with cut and shaped ends out of 4½-in. by 1½-in. stained and French-polished Honduras mahogany, and two teak rods, 1½ in. diameter, 3 ft. long.

Lavatory.—Fit up the enclosure of lavatory basin with

1¼-in. panelled and moulded front, with door hung on a pair of 3-in. brass butts, and fitted with brass turn-buckle fastening. Provide and fix bearers for lavatory basin, and assist plumber in fixing. The top and skirting of lavatory will be in one piece with basin.

Cupboards.—The cupboard in to have 1½-in. framed fronts with a pair of 1½-in. doors hung folding with rebated and beaded stiles, each leaf in three moulded and square panels, and hung with a pair of 4-in. wrought-iron butts. Fit with 4-in. cut cupboard lock, a pair of brass knobs, and a pair of 4-in. neckbolts. Top of cupboard to be ¾ in. and cross-tongued, with rounded nosing and moulding under out of 2½ in. by 1½ in. This cupboard to have one cross-tongued inch shelf, beaded hat-rail 4½ in. by 1 in., with No. 6 wrought-iron hat and cloak-hooks.

Picture Moulding.—Put round walls of 3 ft. below bottom of plaster cornice, picture-moulding out of 3½ in. by 2 in., plugged and screwed to wall every 18 in. apart.

Wall Panelling.—The panelling in dining-room to be 1½ in. framed and panelled as shown on detail drawing; the panels in yellow pine in one width, backed with canvas put on with marine glue, the back of panelling to be served over with the glue, the canvas tacked on and stretched tightly, and a hot iron passed over to melt the glue. The cornice to be framed up out of 7 in. by 3 in. with dentil course and carved egg and tongue moulding planted on (or describe in the same way whatever other decorative treatment may be proposed), the chair rail moulded out of 4½ in. by 2½ in. tongued on, the skirting moulded out of 9 in. by 2 in., and tongued to floor. The carved frieze to be of sycamore, supplied and carved by Mr. , and to be framed in and fitted to panelling by the contractor. Provide the p.c. sum of for this carved frieze, to be paid to Mr. by the contractor within one month after presentation of the architect's certificate. This panelled work to be fixed to 2½-in. by 1¼-in. grounds plugged to wall.

Church Seats.—The seats to be executed in accordance with detail drawing of selected sequoia (or other selected

wood) of quality equal to that of sample in architect's office. One seat to be worked and approved by the architect before the remainder are commenced. The seats to be fixed to floor (describe method, whether tenoned and screwed, or by means of iron brackets or otherwise).

Hard Woods.—Few architects have the very highly specialised knowledge to be able to distinguish between varieties of the same hard wood from different countries, and although the student might specify a certain wood as, say, Riga wainscot, he can hardly be expected to be able to determine by inspection alone whether what he specifies is being supplied. There are, therefore, two courses open to him, either to specify that the wood is to be of a quality equal to that of a sample in architect's office, as example given in last clause, or to quote a reliable timber merchant's name and price—thus: The mahogany is to be from Tobasco, of quality equal to sample approved by the architect, and is to be obtained from Messrs. , whose price at inch thick is 7d. per foot super.

Completion.—The contractor is to leave all woodwork clean and perfect, and any work which may show a shrinking of $\frac{1}{16}$ in. between any two pieces of wood, or which may crack in the substance of any panel or framing, shall be taken out and reinstated, at the contractor's expense, with sound, well-seasoned material. (Clauses of this or similar drastic nature are becoming general in specifications. The use of unseasoned wood is now so common, and the difficulty of detecting it till shrinkage occurs is so difficult, that it is no unusual thing for such defects to make their appearance even before the painting is finished.)

We have in the previous paragraphs given examples of the mode of specifying the most general items of joiner's work, but there are others less general, but occasionally required, of which it may be useful to the student to have instances, and some of these we now give.

Window Shutters.—The windows numbered on plans to have $1\frac{1}{4}$-in. boxing shutters in leaves three panels high, moulded both sides; the back flaps to be also $1\frac{1}{4}$ in. in leaves three panels high, but moulded and square. The shutters to be full height of windows, and hung with a pair

of 3½-in. wrought-iron butts or back flaps as necessary to each leaf, in 1¼-in. cross-tongued and beaded boxings, with architrave moulding out of 3½ in. by 2 in. Each set of shutters to have 1¾-in. by ¼-in. steel shutter bar, 3 ft. long, with spring catch fastener and 14 oz. bell, with spring and clip. All stiles to have rebated and beaded joints.

The windows numbered on plans to have 1¼-in. boxing shutters, 5 ft. 6 in. high, in two panels, moulded and square each leaf, the back flaps to be 1 in. thick in two panels, square both sides. The shutters to be hung in 1-in. cross-tongued and beaded splayed boxings, with a pair of 3-in. wrought-iron butts or back flaps as necessary to each leaf. Each set of shutters to have 1½-in. by $\frac{3}{16}$-in. steel shutter bar, 18 in. long with spring catch fastener. All stiles to have rebated joints.

The windows numbered on plans to have 1¼-in. moulded and square shutters in two panels each leaf, double hung with best flax lines, and brass bushed axle pulleys in deal-cased frames to match those of sashes. Each pair of shutters to have a 4-in. brass shutter screw and socket, and a pair of brass drop shutter rings, and a pair of 3-in. brass flush shutter lifts to each leaf. The boxing to these shutters to have 1¼-in. moulded and square front in two panels tongued to floor, ¾-in. ploughed and tongued back, and 1¼-in. hinged cover with rounded nosing, hung with a pair of 2½-in. brass butts.

The windows numbered on plans to have a pair of 1¼-in. framed outside shutters, with solid panels tongued and V-jointed, hung folding with a pair of 4½-in. wrought-iron parliament hinges to casement frames, and fitted with oak blocks plugged to wall, and strong wrought-iron cockspur shutter fastenings, also a pair of 6 in wrought-iron barrel bolts. Each leaf to have heart-shaped perforation 6 in. by 6 in.

French Casements.—The windows numbered on plans to have 2-in. ovolo moulded French casements, hung folding with hook rebate (or rounded and grooved heels) and moulded weather fillet out of 2½ in. by 1½ in. on meeting stiles, and rounded tongue, 1¼ in. thick, on hanging stiles. The bottom rail and sill to have———'s weather-

bar, p.c. (or specify any other method preferred for keeping out rain between bottom rail and sill, or follow the continental plan of allowing the rain to drift through, and then catch it in condensation gutter and drain away.) The casements to be hung with a pair of 4-in. wrought-iron butts to each leaf, to 4½-in. by 4-in. rebated and beaded frame, with hollow groove as water stop 1⅜ in. wide. Sill to be 6 in. by 4 in. oak, sunk weathered and throated, and fitted with———'s weather-bar, as above mentioned (or otherwise, as the case may be). Put to these casements ⅞-in. brass espagnolette bolts p.c.

Coach House Doors.—The doors of coach-house to be 2½ in. framed, ledged, and braced, the ledges and braces 1½ in. thick, the filling-in of inch matched and V-jointed boarding in half batten widths, stiles, top rail, and braces 5½ in. wide, ledges and bottom rail 9 in. wide. The doors to be hung with a pair of———'s gate hinges 3 ft. 6 in. long, to each leaf, to 6-in. by 4½-in. rebated and chamfered frame, and to be fitted with a 12-in. wrought-iron barrel bolt, and 30-in. wrought-iron rod bolt, and 9-in. oak-bound stock lock.

Stable Doors.—The doors numbered on plans to be 2¼ in., framed ledged and braced, the ledges and braces 1½ in. thick, the filling-in of ¾-in. matched and V-jointed boarding in half batten widths, to be hung in two heights with rebated joint to meeting rails, with a pair of 4-in. wrought-iron butts on each leaf to 4½-in. by 4-in. rebated and chamfered frame. The doors to be fitted with brass flush-handled stable latch, 6-in. wrought-iron barrel bolt, and 8-in. oak-bound stock lock.

Cisterns.—Construct cistern to be placed in roof over with 1½-in. cross-tongued and dovetailed sides and 1¾-in. cross-tongued and dovetailed bottom. The size of cistern to be 4 ft. by 6 ft. by 3 ft. 6 in. internal dimensions. To each internal angle put splayed angle fillet out of 3 in. by 3 in., and leave all internal surfaces fair and clean for plumber. Around outside of cistern, nail tightly-stretched hoop iron, 18 gauge, inch wide, best quality, three rows 6 in. from top and three rows around middle of height. The cover to this cistern to be ¾-in. matched boarding, made in three divisions, each with two ledges 1¼ in. by 4½ in. Fix cistern

in roof on strong fir bearers, and cut necessary holes and dishings for plumber's work.

Dwarf Cupboards.—The method of specifying these would be similar to that already given for ordinary cupboards, except that the top might be of some hard wood and would be described thus: The top to be of 1¼-in. selected Riga wainscot, cross-tongued, and with 1½-in. by 4½-in. ledges on the underside, secured with slotted cups and screws, and buttoned down to framing. The nosing of top to be rounded.

Sliding Partitions.—The sliding partitions in to be 1½-in. framed partitions in (two?) divisions, each division in six panels square, the middle panels open and prepared for 26 oz. sheet glass, the others ½ in. thick. The partitions to be hung from wrought steel rail on bressummers, with two wheels to each division, and oak threshold 4 in. by 3 in., with small tram rail let in, and steel stubs and plates on lower edge of framing. For the wheels, rails, and stubs provide the p.c. sum of , including carriage and delivery on the works. The contractor is to fix these special items of ironmongery as directed. Each division to have also a pair of brass pull handles, p.c. , and mortice locking-latch, p.c. .

(N.B.—There are various patented forms of sliding and folding partitions now on the market which require, usually, some amount of special preparation. The nature of this should be ascertained from the patentee and specified, and a lump sum provision included for the patentee's work, making it quite clear whether the provision does or does not include the carriage, delivery, fixing, priming, painting, or ironmongery.)

Laundry Fittings (domestic).—Fit up laundry with three washing tubs of 1½-in. clean deal wrought both sides, splayed, and put together with dovetailed angles in white lead. The size of tubs to be 2 ft. 6 in. by 1 ft. 9 in., and 12 in. deep internally, and to have 2-in. brass plug, washer and waste, and 1½-in. light lead pipe as waste to empty into channel in floor.

Fit up 1¼-in. clean deal ironing board, where shown on plan, hung with 1½ pair of 4-in. wrought-iron butts and

hanging stile out of 4½ in. by 1¼ in., plugged to wall. Put underneath board two folding trussed brackets out of 2½ in. by 1½ in. with heel blocks and pins. Provide two clothes racks, each 5 ft. long by 3 ft. high, with 2 in. by 2½ in. ends, and three rails 1½ in. by 1¼ in. morticed and tenoned, and pinned to ends. These racks to have pulleys, lines, and belaying cleats for hoisting to ceiling.

Ironmongery.—In specifying ironmongery it is unwise to follow the example of a bill of quantities and dissociate the items from the parts of the building to which they refer. There are, however, general clauses relating to ironmongery which may be given under the one collective heading. For example, if in the case of locks it is necessary that a master-key shall command the whole, it should be specified that the whole of the locks are to be under one mastership, with two (or more, as the case may be) keys to pass. If sub-master-keys are required for various parts, or if there are several masterships, this should be clearly defined.

As regards quality, it is of little use to specify the best quality or to attempt to define the quality, as this varies, by almost imperceptible gradations, from a very high standard to a very low one. The only really satisfactory method for a young architect to adopt is to put himself into the hands of a trustworthy ironmonger, and include in his specification a fixed price for a fixed quality and article which he has already arranged with the ironmonger. There is, of course, a tariff price for ironmongery, and it would be possible to specify the ironmongery by a p.c. price, leaving the ultimate selection till later; but in this case there is the difficulty that different tradesmen treat the tariff differently, and unless the builder knows, before tendering, through whom the ironmongery is to be bought, his estimate must be speculative, unless the architect allows the builder to select the ironmonger—a course which is open to some objections.

CHAPTER IX.

FOUNDER AND SMITH.

MATERIALS.—The cast iron to be of clean, sound castings, sharp and sound, perfectly fair, and out of winding, free from cinder, honey-comb, blow-holes, and other defects. No stopping up or plugging can on any account be permitted. None of the constructive cast-iron work is to be painted until after delivery on the site. All columns are to be cast vertically and in dry sand and of even thickness; and to be subjected to such tests as the architect shall direct at the expense of the contractor. All castings to be rejected if found to be in any place as much as 10 per cent. thinner than they should be, as required by the drawings or specification. The castings to be of soft grey pig-iron of the second melting. All bearings are to be planed smooth.

The constructive wrought iron to be equal in quality to Staffordshire iron of "best" quality, and capable of bearing a tensile strain of 25 tons per square inch of sectional area before fracture, and a strain of 10 tons without permanent set, and to be tested if required by the architect at the expense of the contractor. All bolt and rivet holes to be carefully drilled (if punched holes are to be allowed it should be stated), and all bolts to be of wrought iron with strong, clean Whitworth threads of uniform pitch, and all exposed heads to be hexagonal. All screwed work to have proper internal as well as external threads.

All rivets to be capable of being bent double either hot or cold without cracking.

The steel to be of the best mild steel, capable of bearing a tensile strain of not less than 30 tons to the square inch

nor more than 35 tons. The contraction of area at point of fracture shall be at least 40 per cent.

All steel work required to be bent must be bent cold where practicable. Steel is not to be hammered cold, but all bendings required are to be done by pressure.

Work in other Trades.—Supply and assist to fix all bolts, tie-rods, and other iron-work required in other trades.

Eaves-Gutters.—The eaves-gutters and other rain-water goods to be of ———'s manufacture, medium weight ("heavy" or "light" if desired). Put to all eaves, where shown, cast-iron moulded eaves-gutters to the following sections, as numbered in ———'s list (give full list of the different sections for different situations). The eaves-gutters to be properly bolted together in red-lead cement, and fixed with strong, large-headed screws to the wood-work. All eaves-gutters to have outlets cast on, and such stopped ends, mitres, returned ends, &c., as may be required. All outlets in eaves-gutters to have strong galvanized wire gratings.

Rain-water Pipes.—The rain-water pipes to be placed where shown on the drawings, and to be 3½ in. internal diameter, fixed to stand 2 in. clear of walls with clips and bats. The heads of rain-water pipes to be of selected patterns, for which provide the p.c. sum of 10s. each. Each rain-water pipe to have the necessary swan-neck and plinth bends, and a cast-iron shoe at foot discharging over a gully.

Columns.—The iron columns on ground floor to be hollow, 6 in. diameter, of ¾-in. metal, with plain caps and bases. The face of caps and bases to be planed true. (Specify the bolts or coach screws which would be necessary for fixing the base and cap.)

Rolled Iron Joists.—Supply and fix in position the following rolled iron joists of the size and weights described; the whole to be of English manufacture, and no Belgian joists to be used. (Give a tabular list of the joists, their length, size, position, and weight, thus:) No. 3 rolled iron joists, 15 in. by 5 in., weight 51 lbs. per foot run over ground floor of schoolroom at first-floor level. Similarly describe the steel girders and stanchions.

Iron Railings.—Put over area to basement wrought-iron framed horizontal railing, with 1¼-in. by ½-in. frame, 1¼-in. by ¼-in. bars, 6 in. apart, fixed to a stone curb with lugs let in and run with lead.

Put at the side of basement steps wrought-iron framed railing, with 1½-in. by ¾-in. rounded rail with scroll end, and ½-in. by ½-in. bars 6 in. apart, let into mortices in stone curb, and run with Spence's metal. The guard bars to kitchen windows to be framed, and the whole height of window, with ¾-in. by ¾-in. square bars, placed angleways 6 in. from centre to centre, and two horizontal rails, 2½ in. by ⅝ in.; the bottom end of bars to be framed to bottom of rail, the upper end to pass through rail and finish with pointed ends. The ends of rails to be 18 in. longer than opening, built into wall, split and turned up and down at ends.

Provide the p.c. sum of £200 (two hundred pounds) for front railing, which is to be made and fixed by a smith to be appointed by the architect. The contractor is to prepare stone coping for fixing by cutting number 64 mortices for inch bars 3 in. deep.

Iron Staircase.—Provide the p.c. sum of £15 (fifteen pounds) for circular iron staircase 4 ft. 6 in. diameter, and fix same in position shown on drawing. The staircase to be supplied by Messrs. , to whom the contractor is to pay the p.c. sum of allowed within one month after the production of the architect's certificate.

Iron Casements.—Provide the p.c. sum of for front casements to windows, numbered on plans. These casements are to be properly and truly fixed by the contractor, but will be supplied by Messrs. to whom the contractor is to pay the provisional sum within fourteen days after production of the architect's certificate.

Stoves and Ranges.—Provide the p.c. sum of £25 (twenty-five pounds) for kitchener, and the p.c. sum of £50 (fifty pounds) for No. 10 stoves, all of which are to be supplied by the firm to be selected by the architect, and to be fixed by the contractor,

Copper.—Provide and set in brickwork, as shown on plan, in scullery a 24-in. copper copper, weighing not less than 22 lbs., with the necessary furnace work and flues with soot doors to chimney stack. The brickwork of copper to be built in blue lias lime-mortar, and rendered round the outside in Portland cement. Provide deal pegged copper-lid 2 in. thick in two thicknesses, with cut handle out of 1¾-in. deal.

Chimney Bars.—Provide the wrought-iron chimney bars for fireplace openings as specified in the *Bricklayer.*

Coal-Plate.—Provide ———'s improved safety coal-plate (state catalogue number), 14-in. outside diameter, with circular protecting ring for rebated perforation in York stone cover over coalcellar.

Strong-room Door.—Provide p.c. sum of for strong-room door and frame, size of door opening 2 ft. 6 in. by 6 ft. 6 in., and build in same to brickwork and stone threshold.

Ornamental Balusters to Staircase.—The principal staircase to have ornamental cast-iron balusters, as shown on detail drawings. Short balusters to weigh 14 lbs. each, long ones 18 lbs. All to be finely cast with lugs let into mortices in stone steps, and run with Spence's metal. The tops fitted to top rail of wrought-iron, 1¼ in. by ½ in., and screwed through same to oak hand-rail. The newel to be malleable iron cast from turned wood pattern one-tenth larger than size of finished newel as shown on detail drawing.

Lift.—Provide the sum of p.c. to be paid to Messrs. for hand-power passenger lift, this sum to include delivery and fixing by Messrs. . But the contractor is to allow for attendance upon Messrs. workmen, and for any scaffolding, ladders, or staging that may be required.

Corrugated Iron Roofing.—Roof over covered playground to be carried out as shown on detail drawing, in No. 18 gauge galvanised tinned corrugated iron sheets; bent to curve, and put together with galvanised wrought-iron ¼-in. by ¾-in. bolts and nuts, edges and ends of sheets being properly punched for same. The roof trusses to be executed

as shown on drawings with 3½ in. by 3½ in. by ¼ in. steel ribs, and 1 in. circular tie rods (if eaves gutters, and iron water-pipes are required, specify them as desired).

Stable Fittings.—Provide the p.c. sum of for No. enamelled iron mangers, 6 ft. long, No. 3 ft. angular enamelled iron mangers, No. galvanised iron hay-racks, No. sets of stall division, with heel pillars, moulded ramped top rail, bottom sill, and matched boarding. Fix all these fittings in the position shown on drawings.

Provide the p.c. sum of for enclosures, and doors to loose boxes, and fix same. Provide the p.c. sum of for No. enamelled iron lettered name-plates, to be fixed to wall with plugs and screws.

Ventilation to Stable.—Provide the p.c. sum of for self-acting exhaust ventilator, to be supplied by Messrs. , and fixed by the contractor in turret shown over roof of stable, and connect same to zinc-lined air shaft 18 in. by 18 in. internal dimensions, formed with 1¼-in. deal casing dovetailed at angles, and connected to hollow beam fixed on stable ceiling. This hollow beam to be 12 in. by 6 in. internal dimensions, formed with inch wrought deal bottoms and tops, sides to have 3½-in. by 1-in. wrought deal styles 18 in. apart, dovetailed to top and bottom, and filled in with perforated sheet zinc No. in Messrs.———'s catalogue.

Wrought-Iron Scrapers.—The doors numbered on plans to have ornamental wrought-iron scrapers, as shown on detail drawing, with steel plates riveted to uprights which are to be let into mortices in York-stone base and run with lead.

CHAPTER X.

HOT WATER FITTER.

THERE are two distinct branches of work which come under this heading. First, the supply of hot water to be laid on for use; and second, the provision of heating apparatus, in which the hot water is used simply as a means of transmitting heat. Attempts have sometimes been made to combine these two functions in one apparatus, but the result has never been entirely satisfactory; and it is far better to keep the two distinct, each with its separate arrangement of pipes, &c.

We will therefore give examples of methods of specifying the works for the two different purposes.

In the supply of hot water for domestic purposes there are two opposing systems, under one or other of which various installations are generally classed. First, the cylinder system, which is certainly the safer and more generally adopted; and second, the older tank system. We will commence with the specification of the work required for domestic purposes with the former system.

Hot Water Supply.—The hot water supply to is to be fitted up on the cylinder system in accordance with the following details, and is to be tested to the satisfaction of the architect before being approved :—

Boiler.—The boiler is to be a welded wrought-iron boot boiler, $\frac{3}{8}$-in. metal, to hold gallons, properly set on fire-bricks to form flue under and at back of same, and is to be provided with two manholes, with cast-iron plates and screws. Particular care is to be taken that the manhole covers are absolutely watertight.

Cylinder.—The cylinder is to be a galvanised wrought

iron hot-water cylinder to hold gallons, of $\frac{1}{8}$-in. plate, with wrought-iron manhole plate bolted over the manhole with gun-metal bolts, tapped and screwed with inside strengthening plate (or if preferred an elliptical plate with external iron bridge piece may be specified). The cylinder to be fixed in kitchen in position where directed on strong T iron brackets built into the wall. The cylinder is to be enclosed with $\frac{3}{8}$ in. polished mahogany lagging leaving a space of 2 in. clear between the cylinder and lagging, which is to be filled with slag wool. The lagging to be secured with brass bands $1\frac{1}{2}$ in. wide tightened up with screws. Top and bottom of cylinder enclosures to be $\frac{3}{4}$ in. polished mahogany with rounded nosing.

Pipes.—All the pipes for hot-water work to be wrought welded steam-pipes, each to be fixed to stand 1 in. free from wall and supported on neat brackets of wrought-iron, screwed to blocks plugged to the wall, provision being made for expansion and contraction. No elbows are to be used, but bends on an easy sweep. Branch pipes in all cases to have a bend next to T union. The circulating pipes between boiler and cylinder to be $1\frac{1}{2}$-in. pipes, the main circulating pipes $1\frac{1}{4}$ in., the supply to bath to be 1 in., and to the lavatory basins and sinks $\frac{3}{4}$ in.

In fitting pipes to boiler and cylinder special care is to be taken that the boiler is fixed level, and that no pipes project into the interior of either the boiler or cylinder. The boiler is to be tapped and screwed for pipes which are to have back nut screwed on outside. The connections of pipes to cylinder are to have bosses riveted on for screwing to pipe. The arrangement of pipes where connected to cylinder to be carried out as sketched in margin.

Safety Valves.—The boiler is to be fitted with a dead weight safety valve of approved pattern, arranged to open under pressure of lbs. to the inch. (The pressure will be, of course, arranged to suit the head of water in each case.)

We now proceed with the specification of work for hot-water supply on the tank system.

Hot Water Supply.—The hot-water supply to is to be fitted up on the tank system in accordance with the

following details, and is to be tested to the satisfaction of the architect before being approved.

Boiler.—The boiler is to be a welded wrought-iron saddle boiler $\frac{3}{8}$ in. metal to hold gallons; properly set on solid base of firebricks with flue carried up to back of same, and is to be provided with manhole on top with cast-iron plates and screws. Particular care is to be taken that the manhole cover is absolutely watertight.

Tank.—The hot water tank is to be a galvanised wrought-iron tank, to hold fifty gallons, of 14 B.W.G. thickness, with wrought-iron manhole and plate bolted over the manhole. The tank to be placed in where directed on strong T iron brackets built into the wall. Fit up the supply to same with cast-iron cistern and cover, size 15 in. by $7\frac{1}{2}$ in. by $10\frac{1}{2}$ in.

Pipes.—All the pipes for hot-water work to be welded steam-pipes, each to be fixed to stand 1 in. free from wall, and supported on neat wrought iron brackets, screwed and plugged to the wall, provision being made for expansion and contraction. No elbows are to be used, but bends of an easy sweep. Branch pipes in all cases to have a bend next to T union. The circulating pipes between boiler and tank to be $1\frac{1}{4}$-in. pipes, the supply to both to be 1 in., and to lavatory basins and sink $\frac{3}{4}$ in. The supply pipe from cold-water cistern to feed cistern to be $1\frac{1}{4}$ in., with full way brass ball valves with copper ball. The pipe between the cistern and hot-water tank to be also $1\frac{1}{4}$ in., and to have the necessary dip below hot-water tank. The overflow from cistern to be $1\frac{1}{2}$ in. with full way brass screw union. In fitting pipes to boiler especial care is to be taken that the boiler is fixed level, and that no pipes project into the interior. The boiler is to be properly tapped and screwed for pipes which are to have back nut screwed on outside.

Safety Valve.—The boiler is to be fitted with dead-weight safety-valve, of approved pattern, arranged to open under a pressure of lbs. to the square inch.

We can now take some examples of the method of specifying work for hot-water heating. These may be carried out on either the low-pressure system or high-pressure system.

Heating Apparatus.—The heating apparatus to is to be fitted up on the low-pressure system in accordance with the following details, and is to be tested to the satisfaction of the architect before being approved.

Boiler.—The character of the boiler will depend upon the amount of work which it is required to do, and may vary from a small wrought plain welded saddle boiler to a large Lancashire or Cornish tubular boiler.

Pipes.—The pipes generally used are either 4-in. cast iron or 3-in. wrought iron, except when radiators are used. The specification should stipulate which is to be used, and should specially provide that the size of pipe mentioned, whether 4 in. or 3 in., is to be the internal diameter, and that pipes are not to be less than specified diameter. Also the weight per yard run should be given, which may be, say, 30 lbs. per yard for 4-in. cast-iron pipes. Cast-iron pipes would generally be used only where the pressure is moderate, say, up to 25 ft. head of water, for the sake of the joints.

Joints.—Specification should state what kind is to be used, whether socket joints or flange joints, and give the maker's name of any special kind which it is desired to use,

Valves.—Enumerate the valves required; state their position, and describe whether throttle valves, screw-down valves, screw slide valves or (if wrought-iron pipes) gun-metal valves.

Feed Cistern.—Feed cistern to be a cast-iron cistern (state size, which would vary with the amount of pipe, as it will serve for expansion cistern. Of course, the greater the length of pipe the more expansion must be provided). Feed cistern to have 1 in. supply from cold water cistern with full way gun-metal ball valve and copper ball, and 2 in. overflow with full way gun-metal screw union.

In specifying work for the high-pressure system of heating, the architect must determine whether an expansion tube is to be used, which is the better plan where a very high temperature is required in the pipes, or whether a relief valve is to be employed instead, which admits of the apparatus being worked at a lower pressure, and consequently a lower temperature, and under these circumstances has

some advantages, but the architect must make sure that the relief valve will work properly, as unfortunately many do not. The specification might run thus :—

Heating Apparatus.—The heating apparatus of to be fitted up on the high-pressure system according to the following details, and is to be tested to a pressure of lbs. to the square inch, to the satisfaction of the architect before being approved. The pipes are to be $\frac{7}{8}$-in. bore welded steam barrel, ft. of which is to be coiled round furnace for heating. The furnace to be built in fire bricks, one and a half bricks thick, domed over at top, with ft. super of fire-bars, and the necessary furnace-doors, dampers, flue and soot doors. (Specify the size of expansion tube, which will depend upon the amount of pipe. The expansion for a temperature of 300 deg. is $\frac{1}{10}$th quantity of water in the whole apparatus. This amount, of course, must be increased for a higher temperature or decreased for lower. Specify the position of filling tube with its cap, and any stop-cocks required.)

CHAPTER. XI.

GAS FITTER.

THE usual way of specifying gas fitters' work is as follows:—The gas to be laid on from the Company's mains to the meter in with ½-in. patent strong galvanised wrought-iron welded tube, jointed in red lead cement with all the necessary bends, elbows, T's, crosses, junctions, stopped ends, diminishing sockets, nipples, and other necessary fittings. The gas tubing to be stout composition pipes soldered at joints, and the gas is to be laid on to the following points. The situation of the various lights are then enumerated and the gas fitter is left to use his own discretion as to the size of pipes and method of running. This can hardly be considered satisfactory, as it leaves the way open for the contractor who intends to scamp the work, and does not give a fair chance to the man whose aim is to carry out his work properly.

Another method specially favoured by quantity surveyors is to specify approximately the lengths of piping required, and to enumerate the number of fittings at p.c. prices, leaving all the details to be settled when the building is in progress by the architect. Still another way of getting over the difficulty is to put the work into the hands of a trustworthy gasfitter as a sub-contractor, and include the amount of his price as a provisional sum in the specification.

Assuming, however, that the student will desire to know how to specify gas fitters' work with the same degree of care that he devotes to the work of other trades we may proceed as follows, taking some hints from the useful little handbook published by Messrs. James Stott & Co.

Meter and Service.—The contractor is to give notice to the Gas Company, and obtain from them a properly stamped dry gas meter for lights, and fix same on inch deal shelf, supported on wrought-iron brackets in , and shall pay all fees for connecting the service from the main to meter by the Gas Company.

Pipes.—The pipes are to be wrought-iron welded tubing, with all necessary bends, tees, angles, and connections, and of the weights, and screwed to the standard threads, as shown on schedule below, and are to be capable, when fitted, of resisting an internal pressure of 60 lbs. to the square inch.

Int. Diam. Pipe.	Weight per 100 ft.			Threads per inch.
In.	cwt.	qrs.	lbs.	
¼	0	1	14	19
⅜	0	2	6	19
½	0	3	6	14
¾	1	0	22	14
1	1	3	0	11
1¼	2	1	11	11
1½	2	3	7	11
2	3	3	21	11
2½	5	0	6	11
3	6	0	20	11

Int. Diam. Pipe.	Weight per Ten Elbows.		Weight per Ten Tees.	
In.	lbs.	ozs.	lbs.	ozs.
¼	1	7	1	8
⅜	1	13	2	4
½	2	15	3	0
¾	4	6	5	4
1	6	4	7	10
1¼	10	10	12	15
1½	15	3	16	7
2	22	6	27	0
2½	46	2	50	15
3	73	8	85	5

The contractor is to supply all bends, elbows, sockets, tees, back-nuts, nipples, plugs, caps, wall-hooks, pipe-clips, screws and other material necessary. Bends are to be used in place of elbows wherever possible, and where it is necessary to use elbows they are to be of the pattern known as "round elbows." The pipes are to be stayed by wall-hooks or clips at intervals as stated below.

$\frac{1}{4}$ in., $\frac{3}{8}$ in., and $\frac{1}{2}$ in. pipes, one stay every 6 ft.
$\frac{3}{4}$ in., 1 in., and $1\frac{1}{4}$ in. „ „ 9 ft.
$1\frac{1}{2}$ in., 2 in., $2\frac{1}{2}$ in., and 3 in. „ „ 12 ft.

If composition pipes are to be used they should be specified of the following weights :—

Int. Diam. of pipe. In.	Weight per yard. lbs.	ozs.
$\frac{1}{4}$	0	13
$\frac{5}{16}$	1	0
$\frac{3}{8}$	1	5
$\frac{7}{16}$	1	10
$\frac{1}{2}$	2	2
$\frac{5}{8}$	3	4
$\frac{3}{4}$	4	4
$\frac{7}{8}$	4	12
1	5	8

(If there is any length of piping underground it should preferably be of cast-iron, or if the pipes are of wrought-iron they should be protected by wooden box troughing, packed with dry sand, and flushed with hot pitch.)

No pipes are to be bedded in plaster or in walls, but they are to be kept 1 in. clear from finished surfaces of walls and ceilings. (This is highly desirable for the sake of the pipes, and for the detection of any leakage that may subsequently occur. But if considered unsightly, the architect will use his own discretion as to casing, or even bedding the pipes in the plaster). The gas fitter is to obtain the approval of the architect to all lines of piping, and is not to cut away any joists or other woodwork, except as may be specially allowed by the architect. (Of course, the best way of arranging for gas fitting is to supply drawings showing where pipes are to be placed, but this is very seldom done.)

Floor boards over pipes to be fitted to remove easily, and fixed with brass cups and screws.

Syphon Box.—All gas pipes are to be laid with a slight inclination towards the meter, and a cast-iron syphon-box with a capacity of four gallons and sockets for pipes and fitted with loose lid bolted to flange, and provided with $\frac{3}{4}$-in. wrought-iron suction pipe, is to be fixed where directed near to meter.

Governors.—Provide and fix where directed No. $1\frac{1}{4}$ in. Stott's self-acting gas-governors, No. $\frac{3}{4}$ in., and No. $\frac{1}{2}$ in. ditto.

Stop Cocks.—Provide and fix where directed the following stop-cocks. (Give list for various sizes.) These are to be strong, brass full-way stop-cocks, square headed with loose keys, with brass screw unions to pipes.

Lines of Piping.—The piping to main from to to be $1\frac{1}{4}$-in. wrought-iron gas barrel, with 1-in. secondary mains from to , $\frac{3}{4}$-in. branches from to , and $\frac{1}{2}$-in. supplies to . In laying piping, any pipes that have to be bent shall be first heated to redness and bent whilst hot. Care is to be taken that the sectional area of pipes is not diminished, and no piping will be passed unless it is of full diameter. Joints are to be strongly screwed up, and made firm and gas-tight with white lead and hemp.

Fittings.—Provide and fix No. two arm wrought iron pendants, $\frac{3}{4}$ in. by $\frac{1}{2}$ in. by 60 in. long, No. two arm bronzed brass pendants 1 in. by $\frac{3}{4}$ in. by 54 in. long, No. single jointed bronzed brass brackets $\frac{3}{4}$ in. by 13 in. long. No. stiff wrought-iron brackets $\frac{3}{4}$ in. by 10 in. long, and allow the sum of p.c. for fittings to be selected by the architect to be fixed in the following rooms. (Give a list of the points where the selected fittings are to be used.) The contractor is to provide storage for all fittings when delivered on the premises, as well as the pipes, etc., which he may himself supply, and is to protect same from rust or other damage.

Painting.—All wrought-iron pipes and fittings to be absolutely clean and free from rust before painting, and each to receive one coat of red lead and boiled oil mixed

in small quantities and applied whilst fresh before being fixed, and the interior of the pipes to be painted with red lead and boiled oil and two coats of lead paint afterwards, also before fixing. The exteriors to be painted after fixing with three coats in good lead and oil colours of approved tints, as directed by the architect.

Testing.—Provide the sum of two guineas to be paid for testing the gas fittings by the expert to be appointed by the architect, who will not approve gas fitting until such testing has been done, and the expert's fee paid.

N.B.—In arranging the gas fittings for churches and schools and other public buildings it is generally desirable to provide for by-passes, and the student should therefore specify where he desires these, that No. $\frac{1}{2}$ in. brass cocks and by-passes are to be fixed where directed, the cocks to be lever taps with chains, stating whether brass or iron chains, and stout brass tablets marked "On" and "Off" respectively. Provision must also be made for lamplighters' torches.

When sliding pendants are used with the ordinary water tube arrangements, it is well to specify that a small quantity of olive oil should be poured on top of the water in order to prevent evaporation.

CHAPTER XII.

BELL-HANGER.

HERE are various methods in vogue in bell-hanging, of which the principal are :—A. By means of wires and cranks; B. Electric bells; C. Pneumatic bells.

Commencing with the first, they should be specified as follows :—

Bells.—The bells to be of various tones, and an average weight of 14 oz., with steel spring and brass tee-plate, and back spring carriage, each fitted with pendulum and indicator, and fixed on bell-board placed in position where directed in kitchen.

Bell Board.—The bell-board to be 1¼ in. mahogany, French polished (or deal), with small ovolo moulding on edge, and with name of room written under each bell, showing to which it belongs. Size of bell-board to be by to take (number of) bells.

Wires and Fittings.—The wires to be No. B.W.G. copper wire (size may vary from about No. 10 to No. 15), well stretched, and fitted in concealed zinc tubing, with the necessary cranks, purchases, and levers (or, if the student likes to be very exact, he may specify number and nature of fittings to each bell.)

Bells and Pulls.—Supply and fix the following bells and pulls. The whole list should then be given of the various rooms, with the number of bells and pulls to each, together with their position, and also the situation where the bells are to ring. As for example :—

Drawing-room.—No. 1 bell, with two-lever pull, to ring in kitchen.

Bedroom.—No. 1 bell, with ceiling pull, to ring in kitchen.

Boudoir.—No. 1 bell, with lever pull, to ring in kitchen.

No. 1 bell, with lever-pull, to ring in housekeeper's room.

The pulls to have iron boxes and mouth-pieces, and to be of the following p.c. value. (Give list of the pulls of each kind, with their p.c. value, including, of course, the street-door pull.)

Electric Bells are treated in the chapter on "electric wiring" (see page 92).

Pneumatic Bells.—Bells are to be fitted up on the pneumatic system by Messrs. whose p.c. price for this work is which amount is to be paid to them by the contractor within one month after the production of the architect's certificate. The bells will be fitted up before the plastering is done, and particular care is to be taken by the contractor that no damage is done to tubes, boxings, or other work in connexion with the bells.

N.B.—As pneumatic bell-fitting is rather out of the ordinary run, it is advisable to get a price from a reliable firm, and include that as a provisional amount, especially as the primary essential to successful working is careful workmanship and high quality in material.

Speaking Tubes.—Fit up speaking tubes from to with $\frac{3}{4}$-in. composition tubes (or other size, according to circumstances; $\frac{3}{4}$ in. is a good average. Zinc or copper tube may be used, but, taking all things into consideration, composition tube is generally the most satisfactory).

All bends in speaking tubes to be in cast zinc (or brass), and the tubes are to be finished at ends with brass screw collars, oval mouth-pieces, and whistles, with indicators (state whether the mouth-pieces are to be in cocus wood, ivory, ebony, or boxwood). The ends of speaking tubes in to have silk braided flexible tubing, 3 ft. long, with brass clips, and $\frac{1}{2}$ in. mahogany board. (If, as may sometimes occur, any ends are to have mouth-pieces only, without whistles, enumerate them separately. Generally indicators are advisable with all whistles, but where there is only one whistle at any point, the indicator may be omitted if there is no danger of confusion.)

Telephones are treated of in the chapter on "electric wiring" (see page 90).

A fee for testing by an expert should be included. If the architect has chosen to qualify himself for the testing he is of course entitled to a distinct fee, as it means not only the necessary knowledge but the expenditure of capital in the purchase of delicate instruments.

CHAPTER XIII.

ELECTRIC WIRING.

NEARLY all large installations are put in the hands of a consulting engineer, who, to prevent disagreement or confusion, draws up the specification for the work. No departure from it by the contractor is allowed without the consulting engineer's permission, and the contractor is not compelled to do any work not specified in it. As a rule, therefore, it goes as much into detail as possible. The following represents the general form and wording of a specification for the installation of the electric light in a private residence in the West End. For the sake of brevity, the upper floors are omitted.

The contract will be preceded by certain general clauses which do not differ in intention and effect from those usually attached to any other contract for building work; but there are other clauses which it is advisable to attach specially to a contract for electric wiring, in view of the special nature of the work, and the serious risks which must arise from any incompetent performance of the work. Such are the following:—

All the work mentioned in this specification shall be executed and completed by workmen of undoubted competency, efficiency, and good conduct, and no part of the work shall be done by task work. The contractor shall not make any sub-contract for the execution of the whole or any part of the work to any person whatsoever, without the express permission in writing of the engineer.

Then will follow clauses of much the same character as in a general specification, empowering the engineer to condemn and require the removal of any improper material or such as is not in accordance with the specification, providing for the recovery at law of losses caused by bad work, or the proportionate deduction from the sum to be paid to the contractor, for carrying out the work without

delay and without interference with the work of other contractors, and for the compulsory discharge of incompetent foremen or workmen.

Upon the signing of the contract, the contractor shall supply any sample of material or workmanship hereinafter described that the engineer may demand.

The contractor shall at all times keep on the work a copy of the plans and specifications, drawing and measuring instruments, and such apparatus as shall be necessary for making any test of the work that the engineer may demand.

The contractor shall guarantee to maintain and uphold the work in perfect condition, both electrical and mechanical, for the time of twelve calendar months from the date of the completion of the contract.

Then follow the usual provisions as to payment, and as to the action to be taken in case of death or insolvency of the contractor, which need not be specially gone into.

Description of Work, Quality of Materials, &c.

Cable Mains and Branch Leads.—All mains, sub-mains, and branch leads shall be of copper, having a guaranteed conductivity of at least 93 per cent. pure copper, according to Mathiessen's standard, and they shall be insulated with pure and vulcanised india rubber and taped; the whole vulcanised waterproof so that the insulation of the said mains, sub-mains, and branch leads shall be at least 2,000 megohms per statute mile, and shall be equal to Henley's Class A cables.

No main, sub-main, or branch lead shall consist of a single wire, but shall be composed of small wires stranded together, and the size of each main, sub-main, or branch lead shall be so proportioned that when the maximum current is passing, no more than 600 ampères per square inch section is flowing through any conductor. The smallest sized wires to be used shall be 3/22. The sizes of other branch leads, other than 3/22 are shown in schedule A.

The sizes of mains and sub-mains are shown in schedule B.

Joints.—Joints under floors, or in any inaccessible position,

NOTE.—The form of specification commencing on this page with "Description of Work," &c., down to and inclusive of Schedule E, page 86, is a copy of a specification prepared by Mr. Adrian Collins, Assoc. M.Inst.C.E., of 61, Old Broad Street, E.C., for works which have been executed under his supervision. The sizes of mains, switches, fuses, schedules, &c., applied only to this particular installation, and must not be taken as suitable to all installations generally.

are to be absolutely avoided. The ends of the mains, sub-mains, and branch leads, before being connected to switches, fittings, and fuse boards, &c., shall be carefully stripped of all braiding and felt, care being taken not to injure the rubber insulation, to a distance of at least 3 in., and the exposed rubber shall be carefully cleaned with naphtha, and in no case shall bare wire come in contact with other than the provided metal connexion of fitting, but shall be protected by its vulcanised rubber covering. In soldering the joints, only resin must be used as a flux.

Piping.—All wires or cables shall be run in seamless tempered steel pipes of approved design, in continuous lengths, with all necessary angles and bends soldered thereto. After these pipes are fixed, they shall be painted with a good coat of oil paint. Samples of these pipes shall be sent to the building, and tested and approved by the engineer for resistance to nails, &c. The pipes on top floor are to be run in the roof, and the switch wires are to be run in lacquered brass tubes, for this floor only.

Wall Boxes.—Where the pipes project beyond the point where the branch leads, sub-mains, or mains are drawn from them, a teak block shall be fixed to the wall over the end of the pipe. Where the tubes or casings enter these blocks, they shall be connected with rubber or a suitable compound. These blocks shall serve as fixings for brackets and switches and plugs.

Where mains, sub-mains, or branch leads are run through brick walls or concrete floors, they shall be enclosed in extra strong large steel pipes.

Distributing Boards.—Every branch lead shall be run on both poles, from a point on a double pole distributing fuse-board, so constructed that the boards are built up of separate pieces of metallic conductor, and bars of same mounted on separate pieces of porcelain—one pair for each point—the porcelain being so shaped that one end forms a fireproof division separating the poles. The whole to be enclosed in a hard wood box with glass front, and fitted with lock and key of approved make. The size of these boards are shown in schedule C, and they are to be obtained from Messrs. Z. & Co.

All points on these boards must be labelled with approved ivory tablets.

Samples of these boards are to be submitted for the engineer's approval.

In fixing these boards a fillet of hard wood shall be attached to the wall, and the boards secured to same, having a sheet of india-rubber, $\frac{1}{16}$-in. thick, placed between them.

Provide and fix all necessary clip fuses with porcelain backs.

Double Pole Switch.—Provide and fix a double pole switch, quick make and break, mounted on porcelain, to be enclosed in a hard wood or iron box, with glass front and lock and key. This switch shall be capable of carrying 50 amps. of current at 200 volts pressure.

Main Switch Distributing Board.—Provide and fix a main switch distributing board, consisting of two pieces of slate of best quality, enamelled on both sides and through all holes, and separated by a hard wood fire bar, on which shall be fixed, connected to suitable copper omnibus bars of correct section, three 20 ampère D.P. switches (properly labelled with ivory tablets).

The whole to be enclosed in a hard wood case, with glass front, and provided with a lock and key of approved make.

A sketch of this board must be sent in with tender for the engineer's approval.

Single Pole Switches.—Every light shown in schedule A shall be provided with a quick make and break switch of the "Tumbler" type, mounted on a porcelain base, and provided with an extra heavy metallic cover to be selected.

These switches must be so constructed that there is no possibility of contact between the outside cover and the live contacts.

A sample of these switches shall be submitted to the engineer for his approval.

Switches in places to be assigned by the engineer may be mounted on hard wood blocks, with moulded edges of approved design.

Wall Plugs.—Provide all necessary wall plugs of approved make.

Distribution.—At a point in the basement, to be fixed by the———Electric Supply Co., and at which they will fix their cut-out, the main 19/18, having loops left for meter connection, shall be carried to the double pole switch, and from thence to the three switch distribution board. From each of these switches a 7/18 sub main is to rise to the three boards coloured blue, red, and green on the diagram, from which boards all points of similar colours are to be run on both poles.

Note.—All wires are to be drawn into pipes after plastering is complete, and so that they can be drawn out again if necessary.

Tests.—At such times as the engineer may demand, tests of the work shall be made by the contractor, both for continuity and insulation between the poles and to the earth, and the final test being made at a pressure of 200 volts shall be such that it meets with the entire satisfaction of the engineer of the Electric———Supply Company, and of the———Fire Office.

Provisions.—Provide the sum of £10 p.c.v. for extra wiring, &c., to be deducted in full, or in part, if not required.

Provide the sum of———p.c.v. to be paid to the engineer for copies of plans and specifications.

Notes.—The contractor shall do all the necessary cutting away and shall make good in the best Parian cement, to the engineer's and architect's entire satisfaction, but so as to avoid disturbing the existing arrangements, and shall work to the engineer's express instructions.

All local switches shall be fixed on lock side of door, or where the architect may direct.

When convenient, more than one pair of conductors may be run in one pipe, and, for the purpose of identification, the contractor shall in every case run all the positive leads with red, and all the negative with black wires and cables.

The contractor at the finish of the work shall clean up and remove all débris and superfluous material, &c., that has been caused during the progress of the work, and shall leave all to the satisfaction of the engineer.

SCHEDULE A.

Position of Point.	No. of Points.	Size of Lead other than 3/22.	Description.	Switches.
First Floor.				
Drawing-room	2	7/22	6 pendants	6
Ground Floor.				
Dining-room	1	7/22	14-lt. electrolier	2
Morning-room	1	—	Pendant	1
Billiard-room	1	7/22	6 lt. fitting	2
Water-closet	1	—	Pendant	1
Passage	2	—	2 pendants	2
Entrance.....	1	—	1 pendant	1
Basement.				
Kitchen	1	—	2 pendants	2
Scullery	1	—	1 pendant	1
Pantry.....	1	—	1 ,,	1
Housekeeper's-room ...	1	—	1 ,,	1
Store room	1	—	1 ,,	1
Passage	1	—	1 ,,	1
Water-closet	1	—	1 ,,	1

Note.—The schedules relating to the other floors being practically repetitions of Schedule A are omitted.

SCHEDULE B.

				£		
Kitchen	2 pendants	each	p.c.v.	0	0	0
Scullery	1 pendant	,,	,,	0	0	0
Pantry.....	1 ,, ...	,,	,,	0	0	0
Housekeeper's-room	1 ,, ...	,,	,,	0	0	0
Store-room	1 ,, ...	,,	,,	0	0	0
Passage	1 ,, ...	,,	,,	0	0	0
Water-closet	1 ,, ...	,,	,,	0	0	0
Dining-room	14-lt. electrolier	,,	,,	0	0	0
Billiard-room	6 pendants ...	,,	,,	0	0	0
Morning-room	1 pendant	,,	,,	0	0	0
Water-closet	1 ,, ...	,,	,,	0	0	0
Passage	1 ,, ...	,,	,,	0	0	0
Entrance.....	1 ,, ...	,,	,,	0	0	0
Drawing-room	6 pendants	,,	,,	0	0	0

These prime cost values include complete fittings, including lamp-

holders and fixing; sketches are to be submitted on demand, and the whole or any part of the values may be omitted at the option of the employer.

SCHEDULE C.

Mains, 19/18.	Submain to basement,	7/18.
	,, ground-floor,	7/18.
	,, first-floor,	7/18.

SCHEDULE D.

DISTRIBUTION BOARDS.

Main, 3 way.	20 amp.	Switches and fuses.	200 volts.
Basement,	10 way board.		
Ground-floor,	12 ,,		
First-floor,	14 ,,		This board to have four ways arranged for master switch.

SCHEDULE E.

BELLS.

One push, p.c.v., 15s., to be fixed at entrance. Vulcanised wires to be run in compo tubes to two 6-in. gongs, one in basement passage and one second-floor. A suitable battery to be provided.

Wood Casings.—All cases and covers, except those specially mentioned afterwards, to be of the best American whitewood, the covers being fastened to the casings with screws. When casings are covered with plaster they must be coated inside and outside with shellac varnish. Whenever casings pass through floors they must be protected by a covering of sheet iron extending two inches below the floor and four inches above it. In the dining-room and library the casings must be of oak, and in the drawing-room and boudoir of walnut, moulded to match the existing fittings. Patterns of the moulded covers must be submitted for the approval of the architect.

[When there is no public supply of electricity, a power-house containing a combined mechanical and electrical power plant is necessary. The plant can be packed into very little space, so that some outhouse can usually be found that will serve for this purpose. Of course a great variety of cases arise, and engineers must be guided by circumstances in each special case. The combinations of steam engines, oil engines, gas engines, steam turbines, water turbines, &c., with dynamos and accumulators are almost endless. Where space is limited, a favourite plan is

to have a dynamo direct driven from a steam engine or turbine. A combined steam turbine and dynamo occupies less space than any other plant. It is a good rule, however, never to try experiments with any new prime mover or dynamo, whatever theoretical justification you think you have, and however long the guarantee of the makers. We have had experience with a theoretically perfect gas engine, which ran beautifully for six months, and then its explosions began to make alarming noises, sometimes as loud as a cannon firing. The contractors removed it, and put in one of an older type, but, naturally, there was an interruption of the supply, and the household were put to some inconvenience.]

Steam Engine and Boiler.—One h.p. nominal vertical engine and boiler complete, with all fittings and variable expansion gear. It must make revolutions per minute and be fitted with disc fly-wheel for direct coupling to the dynamo. The variation in speed from no load to full load shall not exceed per cent. The makers are to deliver and erect the engine and boiler at the power house to the satisfaction of the consulting engineer, who may require them to perform any tests on their efficiency or to demonstrate their silent running.

The Foundations for Engine.—The foundations for the engine will be built by our builder according to the drawings and specifications of the makers of the engine. Our builder will also give all necessary assistance in the way of labourers and scaffolding for the erection of the engine, &c.

[The foundations for direct connected outfits extend under both engine and dynamo.]

Gas-Engine.—One h.p. nominal gas engine complete, with fly-wheel and water reservoir.

Oil Engine.—One h.p. nominal oil engine with cistern, igniting apparatus, vaporiser, air-pump, and all appliances.

Dynamo (for two hundred 16-c.p. lamps).—One dynamo capable of delivering 14 kilowatts to an external circuit, when the armature is making revolutions per minute. It must be compound wound with a special switch so that it can be run either as a compound machine for running

the lamps direct or as a shunt machine for charging accumulators. When run as a compound machine the E.M.F. between its terminals is to be 105 volts at no load and not less than 103 volts at full load.

The dynamo to have a sliding cast-iron bedplate with brackets and tightening screws and to be supplied with adjustable sight-feed lubricators.

Armature.—The core to be made of the softest charcoal iron discs. The windings must be wound in separate sections on the core, and be well insulated from it. They must in addition be protected by some varnish which cannot be injured by oil. The minimum insulation resistance between the armature winding and the core to be one megohm.

Field Magnets.—To be of wrought iron, the magnet coils to be wound on wrought-iron cases which can be slipped on and off the field magnets. The insulation of the wires forming the coils to be mechanically strong and the insulation resistance between the coils and the framework of the machine to be greater than one megohm when tested by an Evershed Ohmmeter at 200 volts.

Commutator.—Of hard drawn copper or phosphor bronze, thoroughly insulated with clear mica and turned perfectly true. The segments of sufficient depth to allow a wear of one inch off the radius and so constructed that it is easy to replace them if necessary.

Brushes.—Of copper, carbon tipped or of gauze.

Copper.—All copper used in the construction must have a conductivity of at least 100 per cent. (Matthiessen's Standard).

The *Dynamo* must be guaranteed to be capable of giving an output of 14 kilowatts running continuously for twelve hours without sparking on the commutator or heating the armature or magnet coils, more than 60 deg. Fahr. above that of the surrounding atmosphere. At this load also its *mechanical* efficiency must be guaranteed to be not less than 85 per cent.

[The above dynamo is capable of supplying current to 200 16-p.c. lamps at once, but if we have a battery of accumulators as well, then by keeping the dynamo running

during the day charging the accumulators, and then using them in addition to the dynamo at night we could supply 400 or 600 lamps.]

Accumulators.—A battery of fifty-five accumulators in glass cells capable of supplying a current of 120 ampères for four hours without a fresh charge. (As a 16-p.c. lamp takes 0·6 ampère at 100 volts this battery could supply 200 lamps). Each cell must have a wooden tray supported by glass insulators of mushroom pattern and a glass cover. A guarantee for at least two years must be given, and the cost of maintenance and repairs should be stated.

Battery Switchboard.—This switchboard must contain two dynamo fuses, one dynamo switch, one battery-charging switch, one battery discharging switch, one current indicator, one automatic cut-out, one shunt-regulating switch, one volt meter with switch for same, one ammeter with a special switch, by means of which the current in the dynamo, battery, or mains can be read, two circuit fuses, and one circuit switch.

All the above to be mounted on a plain slate slab, with an oak frame and a plate-glass front, with lock and key. All connections to be made from behind, and thimbles to be provided for cable connections. Every fitting of the board that carries current must be of copper, and the current density must in no case exceed 500 ampères per square inch of contact surface.

It is to be made for 300 ampères.

A drawing of the switchboard to be submitted for the approval of the engineer.

Arc Lamps.—Four 10 ampère arc lamps will be required to run two in series from the 100-volt circuit. The mechanism must be simple and strong, and the volts at the terminals and the watts in the arc must remain constant within 2 per cent. when using a 16 mm. cored carbon for the positive, and a 9 mm. solid rod for the negative carbon. The temperature rise of the regulating coils must not exceed 45 deg. Fahr.

Motor.—One 6 h.p. shunt motor will be required for turning a line of shafting in the workshop. It is to be run direct from the 100-volt circuit and great regularity of speed

is essential. The direction of rotation must be capable of being reversed, and the load is of a very intermittent character. Carbon brushes must be used, and the motor must be enclosed in a fire-proof case. A reversing and a regulating switch and starting resistances to be included in the estimate. When the output is 6 h.-p., the efficiency must be at least 70 per cent., but trustworthiness and mechanical strength will be considered of greater importance than high efficiency.

Electric Ventilator.—The fan to be able to remove 1,500 cubic feet of air per minute when working at full speed. The motor not to take more than 2 ampères at 100 volts, and must run noiselessly. A speed regulator to be fixed.

Combined Motor and Domestic Pump.—The pump must be able to deliver 1,000 gallons per hour to a height of 70 ft., and the motor must not take more than 25 ampères at 100 volts when working at full load. The necessary starting switch and resistance to be included in the estimate.

Telephones.

Sometimes in large hotels, warehouses, flats, &c., telephones are wanted to be fixed up between various rooms. At one time there was a very prevalent belief that telephones were difficult to put up and maintain, but now almost any one who has had experience with ordinary electric bell fitting is prepared to erect them. Supposing that four rooms have to be connected with a central room, and with one another, then the following may be a help when making a specification.

Microphones.—Four combination sets, each consisting of a transmitter with a granular carbon, large watch receiver, circular electric bell mounted on walnut board with battery box containing two No. 2 dry cells. One desk combination set with transmitter, automatic switch ringing key and electric bell, one watch receiver, and one wall plug and cord.

Exchange Annunciator.—One four-line board with plug and cord. Plate-glass front with mechanical replacement. Terminals on the top of the annunciator. The case to be

made of polished walnut. It must be suitable for a metallic circuit system.

Batteries.— In addition to the batteries on the microphone boards, one four-cell Leclanché battery with agglomerate blocks will be required. The cells to be of three-pint size, and to be enclosed in a painted wood box with heavy brass terminals.

Wire.—No. 20 india-rubber, double cotton covered and paraffined copper wire to be used. When wires go through plaster, they must be protected by zinc tubing.

When a country house has to be connected with another more than half a mile off, a magneto call-bell is necessary.

Magneto Machines and Bells.—Two combination sets each consisting of a best quality triple magnet, magneto generator, and two bells, transmitter with an automatic switch and a watch receiver. All fitted on a walnut board with a box containing 2 dry cells. On the top of the magneto machine-box a metal comb lightning arrester to be fixed so as to protect the instruments.

Out of doors it is usual to have the line partly aerial and partly underground.

Underground Work.—One mile of 2/20 twin telephone copper wire, well insulated and lead covered. A sample of the wire to be submitted for approval.

Overhead Work.—Four miles 220 yards of No. 16 phosphor bronze wire (or No. 16 mangan copper wire). All joints made when erecting to be soldered, resin being used as a flux.

Wood Poles.—Forty-two light poles of best Norwegian fir, well creosoted. Each to be 30 ft. long, diameter at the top to be not greater than $6\frac{1}{4}$ in. or less than 5 in., and the diameter, 5 ft. from the butt, to be not less than 8 in. An effective lightning arrester shall be placed on every pole and connected to the ground. (Creosoted poles cannot be properly painted, as the oil oozes through; but unprotected poles are soon attacked by wet rot at the ground line in this country.)

Insulators.—(In specifying for insulators it is well to remember that mechanical strength is quite as important as good electrical insulating properties.)

For over-house work, pole brackets, chimney brackets, wall brackets—to be made of galvanised malleable cast-iron, and well blacked. Bolts, straps, and swivels of galvanised wrought iron.

Electric Bells.

For electric bells in large houses, hotels, clubs, &c., many firms quote at so much per push or per hole in the indicator, the price depending on the difficulty of fitting and on the quality of the material used. The general price depends also on the size of the order, for a twelve-roomed house 25s. per push is about the average price. It is, however, most satisfactory to have a plan of the wiring drawn up and to specify that the wiring be done strictly according to the plan.

Specification for a private house:—

General Conditions.—The same as in all specifications, but it is important to add that on the completion of the work the whole installation must be given up in perfect working order, and that if for any reason the cells burst during the first six months after the completion of the order they must be replaced at the expense of the contractor.

Specification of quality of material, &c. :—

Wires.—All wires to be No. 20 tinned copper wire, covered with pure india-rubber, then double cotton covered and paraffined. In the wiring, all wires leading from the positive pole of the battery to have a red covering, all from the negative pole to have a black covering, and all wires not directly connected to the battery to have a white covering.

Tubes.—To be of zinc, of sufficient section to contain easily the wires along the various paths.

Staples.—Any staples used must be insulated.

Wall Blocks.—A teak block to be driven into the wall and fixed at every point in the diagram where a push or switch is indicated.

Pushes.—The tops of all pushes must unscrew. They must have large ivory plungers, and be fitted with ebonite backs and platinum pointed springs. Specimens, which must harmonise as much as possible with the door furniture

of each room to be submitted to the architect for his approval.

Front Door Pushes.—The front door and servants' door pushes must have water tight barrels containing the contacts, and be mounted on a mahogany block.

Two-way Switches.—One plug switch, marked A on diagram, just inside the front door, to be mounted on an ebonite base. Another, marked B, is in best bedroom. When plug is in one position on A, it makes a circuit with the front door bell downstairs; in the other position, it makes a circuit with the upstairs bell. Every night and morning the positions of the plug are changed. The plug in the best bedroom is to enable any one there to ring either upstairs or downstairs from the push.

Batteries.—Six Leclanché batteries (quart size) with agglomerate blocks, in two painted wood boxes, with heavy brass terminals screwed on them.

Trembling Bells.—Three bells will be required, two in the kitchen passage, and another on the top landing. The front door bell to have a sheep gong 6 in. in diameter, and an indicator drop with mechanical replacement. The other bell in the kitchen passage, and the one on the top landing, to have a cast bell-metal nickelled gong, 4 in. in diameter. The bells must be of best quality and highly finished. They must be contained in solid polished walnut cases, with bevelled edges, covers with brass screws, large, high terminals and brass eyelets, all lacquered. The springs must be of the best tempered steel, and the contacts of platinum.

Indicators.—One fourteen-number indicator and one three-number indicator, each with mechanical replacement. They must be in walnut cases, dovetailed and fitted with plate glass and enamelled zinc fronts. The names of the rooms to be written on the zinc screens in black enamel. On the small screen :—Front door, best bedroom, kitchen. On the large screen placed in kitchen passage :—Backdoor, hall, drawing-room, &c.

Lightning Conductors.

A drawing has to be prepared showing exactly the path

of the lightning conductor, and where points have to be affixed

Specification for a church steeple :—

Conductor.—To be of copper tape, 1 in. broad and $\frac{1}{8}$ in. thick ; 110 ft. of it will be required. It must be fastened to the walls in the position shown in diagram by copper clips and nails. A copper coupling must also be provided to fasten the tape on to the elevation tube, and a copper saddle for the apex.

Elevation Tube.—To be of copper, 6 ft. long and 1 in. in diameter, screwed at both ends.

Points.—Elevation copper rod to have four sharp multiple points on it.

Earth.—The earth plate to be of copper 6 square feet in area and $\frac{1}{8}$ in. thick. The plate to be buried at the point indicated on the diagram and surrounded with a load of coke. The conductor to be soldered on to the earth plate.

For a country house, &c. :—

Galvanised iron rope $\frac{5}{8}$ in. in diameter to be used run up two corners of the house and along the highest points of the roof, single points of iron nickel-plated being taken off at the various points marked in the diagram and specia care being taken to protect the kitchen chimney. The earth plates to be of galvanised iron 5 square feet in area and $\frac{3}{16}$-in. thick. The iron ropes to be soldered on to them and the junctions to be tarred.

CHAPTER XIV.

PLASTERER.

MATERIALS.—All laths to be of the thickness known as "lath and half," rent out of sound Baltic fir, butted at joints, with joints frequently broken, and well nailed with galvanised iron nails. (If any special patent 'athing is to be used, specify thus) :—Lathing throughout to be patent metal lathing to be obtained from (give the name of firm), and nailed in accordance with the instructions of the patentees with wire nails not more than 3 in. apart.

The lime to be fresh well burnt stone lime (or chalk lime if allowed), free from cinders, and to be run into putty at least one month before being used.

The sand to be clean and sharp and to be washed if required. Hair to be sound, long, black ox hair, well beaten up when dry and thoroughly incorporated with the mortar.

Coarse Stuff.—Coarse stuff to be composed of three parts by measure of sand to one part of lime, and 9 lbs. of hair to be added to every yard cube.

Floating and Setting Coats.—The floating coat to be two-thirds fine stuff and one-third sand. Setting coat to be of fine stuff. The pricking-up coat is to be carefully tested with plumb-line and straight-edge, and all depressions properly brought up to level of the surface before the floating coat is laid on. The floating coat is to be laid and worked from carefully prepared screeds.

Ceilings.—The ceiling of to be lath, plaster, and set, all the remaining ceilings to be lath, plaster, float, and set.

Walls.—All inner faces of walls and half-brick partitions to be render, float and set, and all quarter partitions lath, plaster, float, and set. The plaster to be continued behind skirtings. Walls of to be finished with dinged surface.

Angles.—Put rounded angles in Keene's cement to all salient angles internally.

Cornices and Mouldings.—The cornices and mouldings to be run in gauged stuff, composed of four parts putty to one part plaster of Paris. The cornices in to be in. girth. (Give a list of all the cornices for the various rooms, specifying the girth of each. If any are to have enrichments, particularise them, and give p.c. price per foot run for the enrichments.) All moulded plaster-work to be executed in accordance with the architect's full size details, and the mouldings are to be run from sharp cut zinc templates. Wherever required by the mouldings, the plastering is to be dubbed out, or angles roughly cut off brickwork as may be necessary.

Portland Cement.—Run the skirtings in Portland cement, finished with bold torus moulding. (Specify any further work there may be internally in Portland cement, as, for example, apron round the sinks.)

External Plastering.—External plastering may be carried out in Portland cement, lime stucco, or in rough cast. For external plastering a quick-setting Portland cement is desirable, weighing between 90 lb. and 100 lb. per striked bushel, as quickness of setting is usually more desirable than great ultimate strength. It is generally advisable that Portland cement work should be completed at one operation rather than in successive coats. Specify the situation where Portland cement work is to be used and the surface with which each is to be finished. When Portland cement is laid in a number of coats it is absolutely necessary that each successive coat should be laid on before the previous coat is dry, and this must be well scratched to form the key. The brickwork should be well wetted before the first coat is applied.

Trowelled Stucco.—This is intended to produce surfaces which can be subsequently painted and a smoother face is

therefore required. It should be specified thus :—Walls of to be rendered and set in trowelled stucco composed of two parts of fine stuff to one part of very fine clean sand and finished with a wet trowel to a perfectly smooth face.

Rough Cast.—Walls of to be rendered in Portland cement, finished with rough cast coat of lime and small pebbles or fine gravel mixed together in a pail with a small quantity of Russian tallow and yellow ochre for tinting. (This is one method of executing rough cast, but there is also another which should be more properly called pebble dash, and specified thus) :—Walls of to be rendered in Portland cement and floated with lime stucco, after which clean pebbles well washed in a pailful of water, and taken out wet are to be thrown on the surface of the wet stucco, and lightly beaten in with a wet trowel. (The stucco may be tinted, or the pebble dash may be applied direct to the cement rendering, if such an effect be desired.)

Sgraffito Work.—The sgraffito work on is to be executed in the following manner :—First a coat of rendering in Portland cement in the proportion of two parts of sand to one of cement. Then a second coat floated in tinted plaster stucco, and when this is nearly dry a third setting coat of lime putty is to be laid on, not to exceed $\frac{1}{8}$ in. thick, and whilst this is wet and soft the cartoon previously perforated is to be applied, and the design pounced through, and the necessary parts cut away, revealing the tinted stucco coat beneath. (If a variety of tints are to be used in the floating coat, this should be specified, but when the work is of this nature it is generally a little beyond the province of the ordinary plasterer, as considerable care is required in laying the tinted coat.)

Cut or Stamped Plaster Work.—This, although called stamped plaster, is really and properly described as cut plaster work, as stamps are ordinarily not employed. The work is generally done in a somewhat similar manner to sgraffito, save that it is not necessary for the plaster in the floated coat to be tinted, and the work is frequently

carried out without a setting coat of lime putty. It may also be carried out in Portland cement work if in small pieces.

Distempering.—The walls of to be twice distempered to an approved tint. (If particularly delicate colours are to be used, or very bright white, it is advisable to specify that starch should be employed for making the distemper instead of size.) All walls and ceilings before being distempered, are to be carefully stopped, rubbed down, and sized. The ceilings are to be distempered white, broken with a small amount of yellow ochre, instead of black.

Twice Lime White.—The walls of to be pointed with a neat flush joint, and twice lime whited.

Pugging to Floors.—Lay on sound boarding specified in "Joiner," under the whole of first and second floors with pugging composed of equal parts of lime, sand, and chopped hay laid dry, 2 in. thick.

Keene's and other Cements.—Specify the walls and ceilings, if any, which are to be in Keene's cement, distinguishing those which are to be first of all rendered in Portland cement if this is to be done. Keene's and Parian cement may be used as a finishing coat on ordinary lime plaster, but adamant, granite, and some other patent cements it is inadvisable to do in this way. Therefore when the specification says that a particular piece of work is to be finished in Keene's cement, it may be taken to imply that ordinary lime plastering forms the ground for the Keene's. In specifying adamant plaster, &c., it is advisable not to use the word finished, but to specify the number of coats, and say that the work is to be plastered in adamant (or other plaster), particularising the brands which the manufacturers recommend for particular work. So also if the Keene's cement finished coat is to be laid on coarser Keene's beneath.

Modelling and Casting.—Provide the p.c. sum of for modelling and casting ornamental work in . This price is to include delivery on the premises, but the contractor is to allow for fixing in addition.

Tile Paving.—This is very often included under the heading of the plasterer's trade, and should be specified thus :—The entrance hall and approach are to be paved with Messrs. tiles, p.c. 12s. per yard super, including carriage and delivery on the works, and the tiling is to be laid by the contractor on 6-in. bed of concrete floated in cement ; and the tiling is to be laid and jointed in cement. (If the tiling is to be laid in anything of an elaborate pattern, it is generally preferable to let the p.c. price include the cost of laying, this being done by the manufacturer's workmen.)

Wall Tiling and Mosaic Work.—This may be dealt with in a similar manner to the floor tiling. That is, if quite plain and straightforward, the p.c. price to be for the material only, which will be fixed by the contractor, but if elaborate let the p.c. price include the fixing.

Glass Linings to Walls.—The various forms of opaque glass which are now being introduced for wall linings are generally best fixed by the manufacturer's workmen, as they require care, and it is not every contractor who has men capable of doing the work.

Making Good.—The contractor is to cut out defective plaster work, whether from blowing or other causes, and to make good such defects in Keene's cement.

CHAPTER XV.

PLUMBER.

IT is usual to keep separate the external and internal plumbing, and to commence with the specification of the external work.

Materials.—The whole of the sheet lead to be the best new pig lead, properly milled and free from all defects, to be weighed whenever required at the contractor's expense, and to weigh the specified weight. The contractor is to supply all necessary solder, wall hooks, copper nails, &c., required in laying lead work. Solder is not to be used in fixing external lead work save where absolutely necessary, but lead clips of not less than 6 lb. lead are to be used; and for securing edges turned into joints of brickwork, as in aprons and flashings, lead wedges are to be used, and joints are to be pointed in cement. The zinc to be (state trade name), and it is to be supplied and laid by Messrs. with holding-down clips, improved solid stopped ends and ridge plates. No soldering or other rigid fastening is to be used externally. (If the architect has reason to believe that the contractor will employ a competent zinc layer, not a plumber, it may not be necessary to stipulate that the work shall be done by any special firm. But it is very important that zinc should not be laid with rigid fastenings, so as to be perfectly free to expand and contract. Neither copper nor iron nailing must, of course, be used for zinc work).

Lead in Flats and Gutters.—Lay the flat over with 7 lb. lead, laid to a fall of 1½ in. in 10 ft. with 2½-in. rolls, 3 ft. apart, centre to centre, and cross-rebated drips 10 ft. apart, as shown on plan. The drips in all cases to be

2½ in. deep, and the ends of rolls to be properly bossed. The gutters to main roof to be laid with 7 lb. lead, 9 in wide in narrowest part, and turned up 9 in. under slating, and dressed over tilting fillet. (If trough gutters are to be used specify their width and minimum depth). The cesspools to be of 7 lb. lead, 8 in. by 8 in., inside dimensions, and 6 in. deep, with a 3 ft. length of 3½-in. bent drawn lead pipe of the substance of 7 lb. lead, with tafted end soldered to bed of cesspool, which is to be dressed into dished and rebated perforation. These bent lead pipes are to discharge into heads of rain-water pipes.

Lead Valleys.—The valleys of main roof to be laid with 6 lb. lead, 18 in. wide, dressed under slates, and over tilting fillet; the joints in same to be lapped and welted.

Flashings.—Where lead roof abuts against brickwork the lead is to be turned up 5 in. and cover flashings 6 in. wide of 5 lb. lead are to be fixed, turned into joints of brickwood 1½ in. Where the sloping edges of roof abut against vertical sides of dormer, put lead secret gutter 16 in. wide of 5 lb. lead covered with 5 lb. lead flashing, 6 in. wide, with 4 in. laps. This flashing to be close copper nailed to boarded sides of dormer cheeks.

Cheeks of Dormers.—The dormers on roof to have their cheeks covered with 6 lb. lead, secured to boarding with close copper nailing at top, and soldered dots and screws, No 3 to each cheek.

Chimney Gutters.—The gutter at back of chimneys to be of a minimum width of 6 in., laid with 6 lb. lead, turned up 5 in. against brickwork, and with cover flashings of 5 lb. lead, 6 in. wide, fixed in a similar manner to those before described.

Aprons.—Put aprons, 12 in. wide, of 5 lb. lead, to all chimneys and dormers.

Soakers.—Put soakers or secret gutter to hips as already described under "slater."

Skylight.—Specify the lead work round the skylight in a similar manner to that already given for chimney stacks; that is, lead gutter on top, apron at bottom, and soakers or secret gutter at side, either with or without flashings.

Lead Sills.—Cover the sills of with 5 lb. lead,

properly dressed round same, copper nailed at top edge, and with bossed ends to projections.

Pommels of Hips.—Cover the pommels of hips with 6 lb. lead, beaten up, bossed, and fitted to wooden hip knob on roof in accordance with detail.

Lead Rain-water Pipes.—The rain-water pipes to be 3½ in. drawn lead pipes, weighing 13 lbs. per foot run, and each to have ornamental lead ears and tacks purposely made in accordance with detail. The heads to be of 7 lb. lead, bossed, beaten up, and cut in accordance with detail, and each to have No. 2 pieces of strong ¾-in. lead pipe as stiffeners across top, to take long coach screws for fixing. The coach screws to have hexagonal heads, and to be covered with ornamental lead bosses, as shown on details, soldered on.

Lead Eaves Gutters.—Dress the eaves gutters in stone cornice of main roof with 7 lb. lead laid to fall of 1 in. in 10 ft., the joints to be lapped and welted, lead to be dressed over stone cornice projecting ½ in. beyond top member, slightly turned up, secured to stone work with lead plugs and screws and soldered dots 3 ft. apart, and taken up 9 in. under slating. The cesspools to be formed as already described for lead gutters.

Zinc Flats.—Flat over to be covered with No. gauge zinc, laid to a fall of 1½ in. in 10 ft., with capped rolls 2 ft. 10½ in. from centre to centre. Drips to be 2½ in. deep cross rebated and 7 ft. apart.

Zinc Gutters.—Lay the gutters to with (specify zinc as in last paragraph) of a minimum width of 9 in., laid to a fall of 1½ in. in 10 ft., turned up under slates 9 in. on each side, secured with holding down clips. Drips to be 2½ in. deep cross rebated and 7 ft. apart. The cesspools to be in 5 lb. lead, 8 in. by 8 in. inside dimensions, and 6 in. deep, with a 3 ft. length of 3½-in. bent pipe of 6 lb. lead to discharge into head of water-pipe.

Zinc Eaves Gutters.—These are by no means to be recommended, but if used should be specified thus: Eaves gutters to be O.G. moulded 4-in. eaves gutters of (describe gauge, &c., of zinc as before), zinc with stiffening tubes

12 in. apart, and secured to fascia with 5-in. galvanised round-headed screws through each tube.

Internal Plumber.

Lead Pipes.—The pipes to be of the following weights per yard run :—

Wastes :—1 in. ..... 7½ lbs.
1½ in. ..... 15 lbs.
2 in. ..... 18 lbs.
2½ in. ..... 24 lbs.

The services and supplies :—

½ in. ..... 6 lbs.
¾ in. ..... 9 lbs.
1 in. ..... 12 lbs.
1¼ in. ..... 16 lbs.
1½ in. ..... 24 lbs.

Taps.—All the taps to be best quality brass, or gun-metal taps, and unless otherwise described, the bib and stop-cocks to be "fullway" high-pressure screw-down valves. The ball valves to be of the make known as "equilibrium." All bib-taps to have screw ferrules, and all stop-cocks screw unions, so that the taps may be removed for repairs without breaking the joints in the pipes.

Tin lined Pipes.—The whole of the pipes used for cold water supply to be wrought-iron, block tin-lined pipes known as (specify patent or maker's name) to be obtained of and to be put together in accordance with the instructions of the patentee ; (or) the whole of the pipes used for cold water supply to be block tin-lined lead pipe, the joints of which are to be formed with gun-metal linings and screwed sockets, the pipe ends being tafted to linings.

Joints.—All joints in lead pipes are to be wiped soldered joints, and no blow-pipe or bit joints are to be used.

Pipe Fixing.—All horizontal pipes are to be fixed on 1½-in. by 3-in. wrought and splayed fillets, plugged to wall with hollow groove on top side for pipe to lie in, and each to be laid with a fall towards the rising main, so that pipes may be emptied from draw-off tap at bottom of same.

Vertical pipes are to be fixed by face tacks, and not by

pipe clips or wall-hooks. Water pipes in roof are to be cased with ¾-in. deal casing, 6 in. by 6 in. clear inside, packed with slag wool. (Or they may be encased with felt or other good non-conductor, so as to preserve them from frost as far as possible.)

Company's Regulations.—The internal plumbing work is to be carried out in accordance with the regulations of the Water Company, and is to be completed to the satisfaction of their inspector.

Connexion with Main.—Give the necessary notices to the Water Company, and pay their charges for making connexion with main, and make good roads and footways to the satisfaction of the Local Authorities.

Stop-cocks.—Supply and fix where directed in main from company's pipe, 1-in. heavy brass high-pressure screw-down stop-cock, with tee key, and 6-in. stoneware pipe as boxing, carried up to surface of ground and closed with screw cap fitted in with Russian tallow. Supply and fix to each supply pipe from cistern full-way brass high-pressure screw-down stop-cock of the size of pipe in which it occurs.

Rising Main.—Lay 1-in. pipe from company's main to cistern in , and fit same with 1-in. brass high-pressure equilibrium ball valve with copper ball. (If there is more than one cistern, the size of the rising main to each, with its ball valve, must of course be specified.)

Cisterns.—Supply and fix in roof over a galvanised wrought-iron riveted cistern, 6 ft. by 3 ft. by 3 ft. with angle iron stiffeners round bottom, top, and angles and wrought-iron cross-stay, and all necessary perforations for supplies and waste. Supply to this cistern 1-in. deal cross-tongued and ledged cistern cover in two pieces on 2½-in. by 2-in. bearers. Fit to the cistern 1½-in. overflow, with brass cistern connector (or 1½-in. boiler screw-union). The overflow to be taken out through the roof to discharge on front with 5 lb. lead soaker where pipe passes through roof.

Draw-off Tap for Emptying—At foot of rising main supply and fix ¾-in. brass screw-down high-pressure bib-cock, with square-headed spindle and loose spanner for emptying rising main, same to discharge over gully.

Supply Pipes.—Run supply pipes from cistern as follows:—(Give a list of the supplies, stating the size, from cistern to various points of supply to bath, lavatories, water-closets, &c.) The supply pipes to be connected to cistern with brass washer and waste with fly nut and union "full-way" of the size of the respective pipes.

Lavatory.—Fit up the lavatory with Messrs. lavatory fittings as No. in their catalogue, p.c. , with hot and cold supply taps, the price of which is included in the p.c. amount already quoted. Supply and fix 1¼-in. waste pipe from lavatory with drawn lead syphon trap below same, fitted with brass screw cap for cleaning. This waste is to be taken to discharge into slipper shown on plan.

Bath.—Supply and fix where shown on plans Messrs. tinned copper bath (or other as may be selected) No. in their catalogue p.c. . The hot, cold, and waste valves and fittings of this bath to be of Messrs. manufacture, as No. in their catalogue p.c. . Run 1½-in. waste pipe from bath, with drawn lead syphon trap below same fitted with screw cap for cleaning. This waste is to discharge into slipper shown on plan.

Housemaid's Sink.—Supply and fix where shown on plan Messrs. housemaid's sink as No. in their catalogue, p.c. . Run 2-in. waste pipe from housemaid's sink with drawn lead syphon trap below same, fitted with screw cap for cleaning, which waste is to discharge into a slipper shown on plan. (Or as an alternative may be specified thus:) The housemaid's sink to be of 1¼-in. cross-tongued deal sides and bottom dovetailed at angles, the angles filled in with splayed fillet out of 2½ in. by 2½ in., the sink to be lined with 6 lb. lead with soldered angles and copper nailed over top. The waste to have 2½-in. brass plug and chain and cobweb grating with brass washer and waste.

Water-Closets.—The water-closet on first floor to be fitted with Messrs. water-closet apparatus as No. in their catalogue, p.c. , with polished mahogany seat and strong galvanised wrought-iron bearers fixed to brickwork. The price of water-closet, already quoted,

includes the seat and bearers (or does not include the seat and bearers as the case may be). The water supply to this water-closet to be laid on with 1½-in. lead pipe from water waste-preventer on iron brackets fitted 7 ft. above the seat of water-closet. The water waste-preventer to be Messrs. manufacture as No. in their list, p.c. ; this price includes the iron brackets. Run ¾-in. lead pipe from water waste-preventer through wall as overflow. The water-closet apparatus to be connected with the vertical soil-pipe by 4-in. drawn lead soil-pipe, weight 10 lbs. per foot run. Similarly describe the other water-closet apparatus.

Safes.—Put beneath each water-closet apparatus on first floor, also beneath bath and housemaid's sink, a safe of 5 lb. lead, that under water-closet to be by on floor, that under bath by , and that under housemaid's sink by , each to be turned up 4 in. at back and each end and in front to rest over 3½-in. by 3-in. splayed fillet and nailed with copper nails. Each safe to have 1¼ in. lead waste carried 6 in. through outer wall and finished with 1¼-in. brass flap soldered in.

Butler's Sink.—Supply and fix where shown on plan in butler's pantry, a lead-lined sink similar to that already described for housemaid's sink, the size being 2 ft. 6. in. by 1 ft. 6 in. by 1 ft. The waste from this to be as described for housemaid's sink.

Soil Pipes.—The soil pipes to be 4-in drawn lead soil-pipes, weight 10 lbs. per foot, secured to wall with tacks soldered on and to be carried up 2 ft. above eaves in a perfectly straight line, and finished with copper wire globular grating 5 in. diameter soldered in (or if desired one of the numerous forms of ventilators in the market may be specified to be fitted at head of soil-pipe). The lower end of soil-pipe to be soldered to brass flanged collar and cemented to socket of drain pipe.

Iron Soil Pipes.—The soil-pipes from water-closets to be 4-in. heavy cast-iron socketed pipes of Messrs.————'s manufacture, enamelled inside, the joints made with oakum and run with lead and caulked. Y junctions to be put for connexion of lead soil-pipes from water-closets, and the

upper portion to be continued and carried up to a height of 3 ft. above the cornices in a straight line, and finished with copper wire globular cover. (N.B.—Where there is a series of water-closets on different floors connected with the same soil-pipe, it is necessary to specify a light lead 1½-in. air pipe to trap in order to prevent same from being syphoned).

Hydrants.—Lay on water-supply to hydrants direct from main with 2½-in. cast-iron pipe, weight 30 lbs. per 6 ft. length, put together with lead-caulked joints. Provide the sum of £ p.c. to be paid to Messrs. for hydrant fittings, hose, nozzle, &c.

Testing.—The whole of the plumber's work to be tested at completion, to the satisfaction of the architect, all pipes being filled with water, and to stand without loss for six hours.

CHAPTER XVI

GLAZIER.

Quality of Materials.—It is a very usual thing to specify that "all glass is to be of the best description, clear from all bubbles and other imperfections," but as a matter of fact this stipulation is seldom strictly adhered to in the carrying out of the work. It is, in fact, one of those general and loosely-worded requisitions for the very highest quality, which are not intended to be acted upon either by the architect or builder. It is therefore, more satisfactory to indicate precisely the quality which is desired. Thus, for example, sheet glass is made in six qualities, which are known respectively as Picture A, Picture B, Best, Seconds, Thirds, and Fourths. The Picture quality alone is that which is really altogether free from bubbles, and also as flat as can be made. The other qualities differ in their variation from perfect flatness and perfect freedom from bubbles. It would, therefore, be better and more satisfactory to put in a clause such as the following:—All the glass to be of the precise quality described in the specification, to be well puttied and back puttied except where otherwise described, and to be sprigged where required. (Spriggs are made in two sizes, $\frac{1}{2}$ in. and $\frac{3}{4}$ in.; but it is hardly necessary to specify which size is to be used save in exceptional circumstances.) For large panes of glass and skylights it may be as well to specify that the glass is to be puttied with thermo-plastic putty. For glazing to iron, hard putty should be specified thus:—"The iron sashes are to be glazed with hard putty composed of oil and red and white lead." Under this heading should be described the manner in which the edges of glass in door panels are to be bedded, whether in india-

rubber, wash-leather, felt, or flannel. A general clause would apply thus :—All the glazed panels in doors to have the edges blacked and to be bedded in double thickness of white Welsh flannel and fixed with beads, secured with brass cups and screws (or brass screws only, or bradded in for cheap work). In specifying plate glass be sure to indicate whether patent plate or British plate is to be used; patent plate being really sheet glass polished on both sides. Patent plate is made in three qualities: best, seconds, and thirds, and two colours of which the "crystal" or "usual" is the better for window glazing, as it is harder. In British polished plate glass there are three qualities: ordinary, best, and silvering, the latter being only used for looking-glasses, as a general rule.

Sheet Glass.—The windows numbered to on plans to be glazed with 26 oz. sheet glass of "seconds" quality. The windows of scullery to be glazed with 21 oz. sheet glass of "thirds" quality. The windows of larder and pantry to be glazed with 21 oz. sheet glass of "thirds" quality ground on one side.

Rough Plate.—The borrowed light between scullery and corridor to be glazed with rough cast plate $\frac{1}{4}$-in. thick (this is the cheapest variety of plate glass, and there is only one quality but of different thicknesses). Skylight over to be glazed with $\frac{1}{4}$ in. plain rough rolled plate. The roof of conservatory is also to be glazed with the same glass.

Polished Plate Glass.—The windows of reception-rooms, numbered to on plans, to be glazed with British polished plate glass about $\frac{1}{4}$-in. thick, of "best" quality, fixed with beads secured with brass cups and screws.

Embossed Glass.—Specify whether this is to be ordinary embossed, or whether the design is to be worked by sand-blast.

Coloured Glass.—Specify whether the glass is to be coloured sheet with flashed colours, stating the weight, 16 oz., 21 oz., &c., or whether pot-metal or rolled cathedral glass; particularise the colours that are to be used, as the price of glass varies with the colouring.

Lead Lights.—Specify whether the work is to be carried out with broad cames or narrow cames, the kind and

quality of glass to be used, and state if it is to be fixed with stout copper wire bands to wrought-iron saddle bars, the diameter and distance apart of which is to be stated, and explain whether the glass is to be bedded in mastic cement or in white lead.

Iron Casements.—Specify these thus: The windows numbered on plans to have iron casements of Messrs. manufacture as No. in their list p.c. . Gun-metal casements and other specially made articles of this kind should also be specified in a similar manner as provisional items.

Crown Glass.—This is now but seldom used except for the sake of the centre blob or "bullion," and even these are less in favour than they were twenty years ago. The qualities of crown glass are classified as with sheet glass. Specification may be thus: The windows numbered on plans to be glazed with flattened crown glass of "seconds" quality, the small panes having each a "bullion" cut from centre of table.

Doors.—The doors numbered on plans to have the centre panel glazed with patent plate glass of "seconds" quality and No. 4 thickness (the thicknesses are No. 1 to No. 4, weighing about 13 oz. to 24 oz. per ft. super) ground on one side.

The doors numbered on plans to have the upper panel glazed with British polished plate glass of "best" quality and about $\frac{1}{4}$ in. thickness in one square.

Bent Glass.—The windows of circular bay in drawing-room to be glazed with British polished plate glass of "best" quality and about $\frac{1}{4}$ in. thickness, bent to accurately follow curve of bay (which is 15 ft. radius).

Completi n.—Clean and polish all glass and leave same perfect at completion.

CHAPTER XVII.

PAPERHANGER.

THE best way to deal with this trade is as follows:—The paperhangings are to be of Messrs. manufacture, and the several r oms are to be hung with paper of the list price value quoted in the following schedule:

Dining-room 5s. per piece.

Drawing-room 6s. per piece.

Bed-room (No. 1) 2s. 6d. per piece, &c., &c.

Dados, Friezes, and Borders.—Mention expressly which rooms are to have dados, friezes, and borders, and give the width of each.

Hanging of Papers.—All walls which are to be papered are to be rubbed down, stopped, sized, and prepared for paper-hanger. The walls of the following rooms are to be hung with lining paper before the wall paper is hung: Dining-room, drawing-room. All papers are to be cut close.

Damp Walls.—If there is any danger of any of the walls being damp, care must be taken to specify the selected precautionary devices, such as thin sheet-lead or tinfoil, tarred paper, or battening and canvas, or whatever else may be preferred by the architect. In specifying canvas and battening mention that the nails are to be painted and covered over with strips of common paper before the papering is done.

Varnishing Papers.—The wall-paper of staircase to be twice sized and once varnished with good copal varnish (or French oil varnish if the paper is of a delicate colour).

Painting Papers.—Flock paper of ceiling of drawing-room is to be twice sized and painted in three coats of good oil colours to an approved light vellum tint, and flatted.

CHAPTER XVIII.

PAINTER.

MATERIALS.—(In specifying the materials for the painter's trade it should be noted that the highest quality is not that described as "Best.") The oil colours are to be prepared with genuine old white lead and genuine Baltic linseed oil. The paint to be mixed on the premises, and all the materials to be tested, as the architect may direct, at the expense of the contractor. Each coat to be of a different tint, and the finishing coats to be in approved tints.

The wood is to be well rubbed down to a smooth face after each coat of colour; and no coat of paint is to be followed by another until it has been seen and approved by the architect.

The varnish is to be obtained from Messrs. , at the following p.c. price:—

	Per Gallon.
Hard oak varnish, at the p.c. price of	
Pale oak varnish	
Copal varnish	
French oil varnish	

(It is always desirable to specify a given make of varnish with the p.c. price; as it is almost impossible for the architect to determine the precise quality of any varnish that may be brought upon the premises by the contractor.)

Ironwork.—All ironwork before being painted is to be thoroughly cleaned, and if necessary pickled and all rust and scale completely removed.

All ironwork is to have the first coat painted with red lead and oil mixed in small quantities and used fresh.

All ironwork is to have the first red lead coat and two subsequent coats applied before the work is fixed, and the finishing coat only is to be applied after fixing.

The whole of the external ironwork is to be painted with three coats of oil colours after the first red-lead coat, and is to be finished in the following colours. (Describe the various colours which are to be used for various parts of the work, unless the same kind of tint is to be used throughout, in which case, of course, it would be necessary only to mention the one tint.) Eaves gutters are to be painted inside as well as out, and the interior of the rain-water pipes is also to be painted (if desired).

The iron railings to boundary wall to be painted in three coats of (name special paint).

The internal ironwork is to be painted with three coats before fixing, and where visible one coat after fixing.

Woodwork.—All woodwork before being painted is to be knotted, stopped, and primed. The knotting to be used is to be red-lead and size knotting, allowed to remain on at least forty-eight hours, and then rubbed down smooth. No patent knotting is on any account to be used. (Of course it is a matter for the judgment of the individual architect, whether or not he is prepared to allow the use of patent knotting.)

No woodwork is to be sized before priming, but the priming coat is to be mixed with oil.

The paint for external woodwork is to be mixed with boiled oil, that for the internal with raw oil.

Paint the external woodwork in four coats of oil colour of the following tints. (Give a list of the various tints which are to be used, and the work to which they apply.)

The internal woodwork to be painted as follows:—The woodwork in drawing-room and dining-room to be painted in four coats of oil colour to approved tints in party colours, and afterwards varnished with copal varnish.

Woodwork of morning-room and smoking room to be painted in four coats of oil colour, grained imitation walnut, and varnished with pale oak varnish.

Woodwork of offices to be painted in four coats of oil colour of approved tints and varnished with hard oak varnish.

The woodwork of staircase to be twice sized and twice varnished with hard oak varnish, as long a time as possible being left between the two coats of varnish.

Similarly specify any other variations there may be in the method of carrying out the painting of the internal woodwork.

Painted Walls.—The walls of principal staircase are to be painted in as many coats of thin oil colour as may be required to enable the work to bear out over the whole surface, after which they are to receive two coats further of oil colour, and to be finished with a flatted coat of approved tint.

Oiling Woodwork.—The wrought wainscoat woodwork of is to be brushed down with a clean, soft brush, and once oiled with a coat of olive oil.

French and other Polish.—The mahogany woodwork in to be stained and French polished to match an approved sample. The woodwork of to be dull polished with egg-shell gloss. Woodwork of to be ebonised and polished.

Gilding.—The surface of is to be dead gilded in oil size with best English double gold. (Gilding of woodwork is done in oil size, that of plaster in water size.)

Stencil Decorations.—Frieze in is to receive stencil decoration, full-size cartoons of which will be supplied by the architect, and they are to be prepared and cut out by the contractor and returned to the architect after using. The ties in stencilling are not to be painted out but to be left. (If the stencilling is to be done in more than one colour it should be stated.) The workman in stencilling is not to attempt to produce an even tone of colour, but to leave same in a naturally broken state.

Lettering.—The following lettering is to be included in the contract and carried out as directed. The letters on glass panels of doors to offices to have the following names in block letters 1½ in. high in black. (Describe also any other lettering stating the material on which the lettering is to be, the size of the letter, character of the alphabet, and the colour of the lettering.)

Completion.—Touch up all painted work on completion, make good all defects, and leave perfect; black stoves, scrub floors, clean windows; and leave the whole of the premises clean and ready for occupation.

CHAPTER XIX.

CONDITIONS OF CONTRACT.

THE conditions of contract are very frequently modelled upon the headings prepared by the Royal Institute of British Architects and the London Builders' Society in 1870; or on the schedule prepared by the Institute in 1895, which latter, however, does not meet with the complete approval of the builders; and the student may, if he thinks fit, adopt one or the other of these models. Or he may, if he prefer, adopt the suggested headings which we now give.

No. 1.—The contractors shall execute and completely finish in a good, substantial, and workmanlike manner, in accordance with the directions, and to the satisfaction, of the architect, the several works shown and described in the drawings and specification, and such further drawings, details, and instructions as may from time to time be given by the architect in explanation. The contractors hereby admit that the said plans and specification are sufficient for their intended purposes, and that the works can be successfully executed in accordance therewith, without any additional or extra work other than such work as is necessarily implied therein, or to be inferred therefrom upon a fair and liberal construction. In case of any apparent discrepancy between the drawings and specification, the architect is to decide which shall be followed. (Before the contract is signed the contractors should have ample opportunity of examining drawings and specification, and all necessary details should be prepared and furnished before the signing of the contract. The new conditions of the Institute provide for an infringement of this desirable rule by stipulating that the architect shall furnish details within a certain time after the receipt of request for same.) A complete copy of the drawings and specification shall be furnished by the architect free of cost to the contractors, and shall be kept on the works until completion of the contract, for the joint use of the contractors and the architect, or their representatives.

No. 2.—The contractors shall commence the said works within one week after date of signing of the contract, and shall actively prosecute the same from day to day until the same works shall in all respects be completed within months from the date of such signing of the contract as aforesaid, provided always that in case the contractors shall be prevented from complying with this article by any strike, lock-out, or combination by or among the workmen, or by any exceptionally inclement weather, or other causes that in the judgment of the architect may be beyond the contractors' control, the architect shall extend the time for completion of the works for such period as he may think fit, and in the event of any such delay occurring the contractors shall at once inform the architect of the fact in writing, and request him to make such extension of the time for completion.

No. 3.—The contractors are to set out the works and are to be responsible for any errors that may arise, either in the original setting out or during the progress of the works, and are to amend such errors whenever required so to do by the architect.

No. 4.—All materials to be used in the said works, although not particularly mentioned in the specification and, save as otherwise provided by the specification, or as may hereafter be otherwise required in writing by the architect, shall be supplied and furnished by the contractors.

No. 5.—All materials and workmanship shall be of precisely the kind and quality described in the specification, and the contractors shall, upon the request of the architect, furnish him with vouchers, or apply such tests as he may direct to prove that the materials and workmanship are such as are specified.

No. 6.—The contractors shall within one week from the completion of the said works remove all scaffolding, plant, materials, and rubbish from the premises, and leave premises in a clean and proper state.

No. 7.—The architect is to have at all times access to the works, which are to be under his control, with power to order any deviation therein or extra works he may consider necessary. The clerk of works is in his absence to be considered his deputy, and the reasonable directions of the

clerk of works are to be attended to by the contractors, subject to appeal to the architect. And the contractors shall afford the clerk of works every reasonable facility for examining the works and materials. The clerk of works shall have no power to direct any variation in the contract, or to give orders for any extra works. The architect may require the contractors to dismiss the foreman or any person employed on the works who may be incompetent or misconduct himself, and such person shall not be again employed on the works without the architect's consent. The contractors are not to sublet the works, or any part thereof, without the consent, in writing, of the architect.

No. 8.—The contractors are not to deviate from the drawings or specification unless upon the directions of the architect shown by an order in writing, or by any plan or drawing expressly given and signed by the architect as an extra or variation or unless required to comply with the provisions of any Act of Parliament or the requirements of any local authority. No charge for day work is to be allowed as such unless a written authority by the architect shall expressly say it is to be done as day work, or unless the work cannot, from its character, be reasonably valued by measurements. All vouchers for day work are to be delivered to the architect within fourteen days after the work may have been executed.

No. 9.—Any variation made in carrying out the work is not to vitiate the contract, but the value of any such variation, for which a price may not have been previously given and agreed upon is to be measured and valued and certified for by the architect, and added to or deducted from the amount of contract. For the purposes of valuation of such variation the Bill of Quantities and prices therein are to be used as a basis of estimate. And for this purpose a verified copy of the original priced bills of quantities shall be deposited with the architect within one week after the signing of the contract.

No. 10.—All materials, including scaffolding, tools, implements, machinery, plant, and effects, which may from time to time during the progress of the works be in, upon, or about the premises for use in the said works, shall be

deemed to be the absolute property of the employer. But the contractors shall, notwithstanding, be solely responsible for the loss or destruction thereof, and for any damage which may happen thereto by fire, tempest, or any other cause whatsoever, and the contractors shall likewise be liable to make good all damage which may happen to persons or things from any cause whatever during the progress of the works. The contractors are not to bring upon the premises any other materials, scaffolding, tools, implements, machinery, plant, or other matters except those which are actually required for the carrying out of these works.

No. 11.—In executing the said works, the contractors shall not go into possession of, enter upon, or in any way use any part of the land or premises the property of the employer other than that which the architect shall have given permission for the contractors to enter upon for carrying out the said works.

No. 12.—The architect shall have full power to require the removal from the premises of all materials which in his opinion are not in accordance with the specification or the instructions of the architect, and to require the substitution of proper materials or workmanship in accordance with the drawings and specification or instructions. And the contractors shall forthwith carry out such order or requirements. The contractors shall, when so requested by the architect, within such time as the architect shall name, open for inspection any work covered up. And in the event of the contractors refusing or neglecting to comply with such request, the architect may employ any other person or persons to open up the same.

No. 13.—In case at any time during the progress of the works any unnecessary delay shall, in the opinion of the architect, occur in the carrying on of the same, and the architect shall give to the contractors, or leave at their then or last-known place of abode or business, or on the said premises, a written notice to proceed with the said works, and the contractors shall not so proceed to the satisfaction of the architect within fourteen days after such notice shall have been so given or left; or in case the contractors shall at any time or times neglect or omit to pull down or remove

any work or materials which the architect shall have certified in writing to be defective or not according to contract within five days after written notice so to do shall have been given to them by the architect, or left as aforesaid, or within such further time as may be specified in the notice; or in case the contractor shall assign, sublet, or charge this contract, or any part thereof, without the permission of the architect; then and in such case the employer shall be at liberty, without vitiating this contract, to take the said works wholly or partially out of the hands of the contractors and to employ any other person or persons to execute the same, and for that purpose to take possession of and use all materials, scaffolding, plant, tools, implements and goods on or about the said works, and all expenses or damages thereby incurred shall be ascertained and certified by the architect, and shall be paid by the contractors to the employer.

No. 14.—The contractors shall maintain and keep the works in good and permanent repair, state, and condition, to the satisfaction of the architect, for months after the date when the architect shall certify that the works have been completed in a satisfactory manner. And any defects, shrinkage, or other faults in the works which may appear within such time from the completion of the building, are to be amended and made good by the contractors at their own cost, and in case of default the employer may employ and pay other persons to amend and make good such defects, shrinkage, or other faults or damage.

No. 15.—Any cost incurred by the employer in carrying out any works for which by this contract he is entitled to employ any other person or persons in default of the contractors, may be recovered by the employer from the contractors, or deducted from any money or monies that may be due to the contractors from the employer.

No. 16.—The building from the commencement of the works to the completion of the same is to be under the contractors' charge, and they are to be responsible for and make good all injuries or damages which may occur to the works or to any person or things occasioned by fire, or by causes over which the contractors shall have control. And

they are to hold the employer indemnified against any claims for injuries to persons or property which may happen from any neglect, default, want of proper care, or misconduct on the part of the contractors, or of any one in their employ. The contractors shall also be responsible for all injuries caused to the works by lightning, frost, or other inclemency of weather, and shall make good and reinstate all damage caused by the same.

No. 17.—The contractors are to insure, in an office approved by the architect, the buildings and works against loss by fire, in the joint names of the employer and contractors, for the full value of the works executed. And they shall, upon request, deposit with the architect the policy and receipts for the premiums paid for such insurance. In case of neglect of the contractors to insure or to deposit with the architect the policy and receipts for the premiums, the employer shall have power to insure and deduct the amount of premiums from the amount payable to the contractors. All monies received under any such policies shall be applied in or towards rebuilding or reparation of the building destroyed or injured, and shall be paid to the contractors by instalments on the certificates of the architect when such rebuilding or reparation of the buildings shall have been carried out. In the event of any damage by fire the architect shall determine and set out in writing the extension of time which the contractors shall be allowed for carrying out the rebuilding or reparation of the premises.

No. 18.—The employer shall at all times have free access to the works and shall have full power to send upon the premises any other person or persons to execute any works not included in this contract, and the architect shall have power to send upon the premises any other person or persons he may select to carry out any works for which provisional sums are included in the specification. And the contractors are to afford every reasonable facility during working hours to such person or persons. And the contractors are to be responsible for any damage that may happen to any work executed by such person or persons in the absence of such person or persons or when such works may have been completed.

No. 19. — If the contractors shall make default in completing the works within the time allowed by clause No. 2, or within any extension of time allowed by the architect for the completion of the works, then the contractors shall pay or allow to the employer, as and by way of liquidated and agreed damages, the sum of £ per week for each and every week during which they shall be so in default until the whole works shall be so completed, provided that the architect shall certify, in writing, that the works could have been completed by the said date, or within the said extended time.

No. 20.—When the value of the works executed and fixed, and not included in any former certificate, shall from time to time amount to the sum of £ , the contractors shall be entitled, upon the certificate of the architect, to receive payment at the rate of 75 per cent. upon such value, until the difference between such percentage and such value shall amount to a sum equal to per cent. upon the amount of the contract, after which time the contractors shall be entitled, on the certificate of the architect, to receive payment in full for all works executed and fixed, and not included in any former payment. And when the works shall be completed, or possession of the building shall have been given to the employer, the contractors shall be entitled to receive one-half of the amount remaining due in the opinion of the architect, and the contractors shall be entitled to receive the balance of any monies due and payable to them under the contract, within months from the completion of the works, or from the date of giving up possession to the employer. A certificate of the architect, or award of a referee or referees or umpire, showing the amount of the final balance due to the contractors, is to be conclusive evidence of the completion of the works. But no certificate is to relieve the contractors from their liability to amend and make good any defects or other faults as provided in these conditions.

No. 21.—If the employer shall make default in paying any monies to which the contractors may become entitled for days after the amount thereof shall have been certified by the architect or determined by arbitration, or if the

works be delayed for months by or under any proceedings by any other parties against the employer, the contractors are to be at liberty to suspend the works and to determine the contract by notice in writing to the architect, and to recover from the employer payment for all works executed, and for any loss upon goods or materials supplied, purchased, or prepared for the works, whether they are delivered on the ground or not.

No. 22.—The amounts included in the specification as prime cost amounts are to mean the sums paid after deduction of all trade discounts, but not deducting bonâ-fide cash discount. In the event of such provisional sums not being expended, or being only partially expended, the contractors shall only be entitled to receive a proportionate amount of their profit on such provisional sums based upon the profits shown in the prices included in the original and deposited bills of quantities. The contractors shall provide and erect all necessary scaffolding and the attendance of labourers and craftsmen, as may be necessary for the purposes of preparation or cutting away for or making good after the persons employed by the architect in the expenditure of such provisional sums.

No. 23.—In the event of any dispute or difference arising between the employer or the architect on his behalf and the contractors as to the amount that ought to be added to or deducted from the contract sum by reason of any additions, omissions, or variations, or in respect of the amounts of any certificate, or of an allowance of extra time for non-completion of the contract; or as to any other matter or thing arising under or out of this contract, except as to matters left to the sole decision or requisition of the architect by the specification or these conditions, then such dispute or difference shall be referred from time to time without any suit at law or equity to the arbitration and final decision of architect. Or in the event of his death, or unwillingness or inability to act, then of an architect, being a Fellow of the Royal Institute of British Architects, to be appointed on request of either party by the President, at the time being, of the Royal Institute of British Architects, and the award of such arbitrator shall be final and binding on all parties. And the award of such arbitrator shall be equivalent

to a certificate of the architect, and the contractor shall be paid accordingly.

No. 24.—The costs of and incidental to any such reference shall be in the discretion of the arbitrator, whose decision shall be final and binding upon all parties without any power of appeal, and this submission may be made a rule of any division of the High Court of Justice upon the application of either party.

To complete the documents forming the contract, and in addition to the drawings, specification, and conditions, there should also be a short agreement, a form for which has been prepared by the Institute, or it may be in some such form as follows:—

This Agreement, made and entered into this day of , between , of , hereinafter called the employer, of the one part, and , of , hereinafter called the contractors, of the other part; *Witnesseth* that for and in consideration of the sum of £ being paid by the said employer to the said contractors the said contractors hereby agree to carry out and perform all the necessary works required in the erection of , on a site situate , and more particularly and fully shown and described in the drawings numbered to , and in the specification prepared by , the architect referred to in such specification. And the said contractors further agree to abide by and be satisfied with the conditions of contract appended to such specification, and to carry out the whole of such works in accordance with such conditions, and to the satisfaction of the said architect. And the said employer agrees to pay to the said contractors the sum of money hereinbefore mentioned, when such works shall have been carried out, and shall have been certified by the said architect to have been completed in accordance with such conditions of contract, and to his satisfaction. *As witness* the hands of the said parties this day of

Signed in the presence of

CHAPTER XX.

ALTERATIONS.

IN specifying work that has to be done to carry out alterations, it is a great mistake to attempt to divide the work strictly into the several trades as is ordinarily done in specifying for new work. It is far better to specify the whole work connected with any particular piece of alteration, dealing with the work in all trades.

As it frequently happens in carrying out alterations that part of the premises only can be given up to the builder at one time, it is important to express clearly to what extent and at what times the builder will be allowed to have access to the different parts of the premises. There will, therefore, generally have to be some special clause defining the *modus operandi*, thus :—

Contractors are to commence with the additions to the existing buildings shown on the plans. These are to be completely finished, and possession of the same given up by the day of . The existing building consists of three distinct blocks, the work in each of which is to be carried out and completed before the contractors can be allowed to enter upon the others. Commencing with the building nearest the street the blocks are designated as follows :—Front block, central block, and rear block. The contractors will be allowed to commence work in the front block one week after giving up possession of the new additions. The works in the front block are then to be entirely completed, and possession of the same given up by the day of .
In a similar manner the contractors will be allowed to enter upon the central block one week after possession has been given up of the front block. The works of the central block are to be completed by the day of , and the contractor will be allowed to enter upon the rear

block one week after possession has been given up of the central block.

The contractors are to provide, fix, and remove temporary efficient screens of canvas and paper to shut off parts of the buildings in which they are working from those in the occupation of the employer.

The names of rooms, &c., shown on plans are their new designation.

State whether the contractors are to be allowed to make use of water and gas, but stipulate that they are to pay for same, and arrange how the amount of payment is to be fixed. Specify if any temporary corridors or staircases or passage-ways are necessary, how these are to be arranged, and in what way they are to be formed. Also that the contractors are to remove same and make good any damage that may be caused.

The general description of quality of materials and workmanship should precede the detailed specification of the various works that are to be carried out in the various parts —of some typical items of which examples will now be given.

Front Block.

Basement.—Carefully take out and remove the present window of the heating chamber together with the arch and sill, and brick up opening with 18-in. brickwork in cement, properly bonded to old work, for which toothings are to be drawn, and pin up over same to old work. Fill up area outside old window opening with hard dry brick rubbish, finished with 6-in. bed of Portland cement concrete floated in cement to receive new tile floor above. Cut out opening for new window where shown on plan, &c. (Describe all the works connected with this new window opening in all trades).

Ground Floor.—Form opening in cross wall of new entrance hall 7 ft. by 9 ft. extreme. Make good jambs in brickwork in cement, and turn relieving arch over in three half-brick rings in cement, angles roughly chamfered to receive new plaster moulded arch. Make good flooring through opening to match existing floor.

Form jambs of new opening in two-coat work in Keene's cement finished with rounded angles, and run in Keene's cement moulded arch 18-in. girth to detail. Make good plastering of existing walls to the new opening, and provide and fix short piece of skirting to each jamb to match, and properly mitred to the old skirting of rooms.

Remove the present staircase and make good the plastering and flooring. Cut away wall on each side of existing opening to form new opening 10 ft. wide and 9 ft. high; make good jambs in brickwork in cement. Insert a bressummer formed of No. 3 9-in. by 3-in. deals bolted together with $\frac{3}{4}$-in. bolts to carry wall over, and resting on 3-in. tooled York template at each end. Fill in the opening thus formed with 2-in. framed, panelled, and moulded partitions, the upper part open and prepared for glass with mitred shifting beads fitted with brass cups and screws, and glazed with British polished plate glass about $\frac{1}{4}$ in. thick, bedded in flannel. Form door in same to match partition, hung with a pair of 4-in. wrought-iron butts, and fitted with 6-in. mortice lock, p.c. 7s. 6d., with brass furniture both sides. Make good all work disturbed around new opening.

Take down and remove the existing wall separating from . Shore up upper portion of wall, and insert rolled steel girder, weight lbs. per foot run, to be obtained from Messrs. , cost of which is included in the p.c. amount provided for iron work. Build in to receive ends of girder 3-in. tooled York templates, 14 in. by 9 in. Fix under middle of this girder cast-iron column, 6 in. diameter, ft. long, weighing lbs., which will also be supplied by Messrs. , and the price of which is also included in the provisional amount already referred to. Excavate for and form good and firm foundation for this column of 18-in. bed of Portland cement concrete, 3 ft. 6 in. by 3 ft. 6 in., as shown on plan, the bottom of same being 3 ft. below level of floor, and build on same 14-in. pier in blue Staffordshire bricks in cement, covered with 4-in. tooled York stone base to receive iron column, which is to be bedded on a sheet of 7-lb lead. (Continue description of works connected with

this alteration by describing the treatment to be adopted in casing or otherwise of the steel girder and column.)

Cellar.—In the formation of new cellar shown on plan the existing external wall of scullery is to be underpinned in the following manner. The whole of the footings and concrete under existing wall are to be removed, and the new wall of cellar is to be carried up as shown on section in 18-in. work in cement tightly pinned up to lowest course of existing wall with slates, tiles, or hard stone in cement. The concrete under the new wall is to be composed of five parts of ballast to two parts of sand, and one part cement by measure. This work is to be carried out in one yard lengths, alternate lengths throughout the length of wall to be first of all built, completed, and pinned up, and then followed by the remaining lengths which are to be toothed and bonded to those first built up. All brickwork in underpinning is to have buttered joints and to be fully flushed up at each course. (If there is damp ground on other side of the wall which is going to be underpinned it will, of course, be necessary to specify the precise method of guarding against this difficulty.)

Raising Roof of Shed.—Remove the roof of shed between scullery and boundary wall, take off coping and top course of wall, and raise same a height of 3-ft. 6-in., as shown on drawings, in brickwork in cement, and form zinc flat over shed, with 4½-in. by 2-in. rafters on 4-in. by 3-in. plates, and covered with inch rough boarding, with edges shot for zinc, and cover same with No. 15 gauge zinc, with 2½-in. drips and 2½-in. rolls where shown on plan. Put to this roof inch wrought and beaded fascia, and 4-in. ogee moulded cast-iron eaves gutter, and 3-in. rainwater pipe discharging into slipper shown on plan.

Removal of Sink and Drain.—Remove sink in present scullery, take out and remove the whole of the drain from same for its entire length under the existing building, sprinkle bottom and sides of trench of same with fresh burnt lime at the rate of one bushel to the yard. Ram bottom of trench and fill in with lime concrete up to, and make good, present cement floor of scullery. Search for junction of drain from this sink with main drain in yard,

and cut off and disconnect the old drain from scullery sink. Clean out with brush the length of drain, disconnect and afterwards sweep through same a bushel of fresh lime and hermetically seal ends of this old drain with slates and cement. The water supplies to this scullery sink are to be diverted to supply new sink described among general works under "Plumber."

First Floor Water-closet.—Take down and remove the present pan closet together with seat and other fittings, disconnect and remove supply pipe to same and waste preventer of cistern. The connexion with main cistern to serve for supply to new water-closet, but with this exception the whole of the plumbing connected with the present water-closet is to be taken down and removed. Take out and remove present soil-pipe and casing, also the drain for same running under present library, the trench of which is to be treated in a similar manner to that described for scullery sink. Take down and remove present dwarf partitions between water-closet and bath-room; take up the floor of present water-closet and relay with new 1¼-in. yellow deal tongued flooring. Make good plastering, skirting, and any other works disturbed. (Then proceed to specify the work of the new water-closet in the ordinary way.)

Cold Larder.—Excavate site of new cold larder to a depth of 2 ft. below corridor floor, and for trenches for foundations of new walls to the depth shown on drawings. The concrete of these foundations to be as described for new additions. Cut a chase 4½ in. wide, and 4½ in. deep in old wall, where new walls of cold larder join them. Carry up new walls in good, hard stock bricks, the work generally to match adjoining work. The damp course to be as specified for new additions. The external walls of cold larder to be built where shown as cavity walls of two sections, the outer 4½-in., the inner 9-in. thick, with 2½-in. cavity, and the sections are to be bonded with wrought-iron wall ties, tarred and sanded before being used, and built in 3 ft. apart in every third course. The window opening to have gauged arch in red brick, and red brick on edge sill, set in cement, with double tile course under projecting 1½ in.

from face of wall. Window opening to have 9-in. by 3-in. lintel, 4½-in. by 3 in. rebated and twice chamfered casement frame, with 5-in. by 4-in. sunk, weathered, and throated oak sill. The sashes to be 2-in. ovolo moulded casements, hung to open inwards, with a pair of 3-in. wrought-iron butts, and fitted with strong malleable iron cockspur casement fastening and strong 18-in. malleable iron casement staybar fastening. Fix outside frame fine perforated zinc, No. 15 gauge, with the top edge turned outwards, about ½ in. from top. Floor of this larder to be formed with 6-in. square red tiles, laid and jointed in cement on bed of 6-in. concrete, and the necessary dry brick rubbish to bring up level of same. Cut and form opening for doorway to larder in 14-in. old wall, build in 3-in. lintel, with rough relieving arch over, in two half-brick rings in cement. Put solid door frame, 4½-in. by 4-in., rebated and twice rounded, with wrought-iron dowel pins let into 3-in. tooled York stone threshold 14-in. wide, back jointed to old and new floor. The door to be 1¾-in. 4-panel moulded and square door, hung with a pair of 4-in. wrought-iron butts, and fitted with rim lock and brass furniture, p.c. . Form roof over cold larder with 6-in. by 6-in. timbers, cut diagonally and laid as shown on section, as support for concrete roof composed of five parts of coke breeze to one part of Portland cement, and finished with Portland cement face neatly floated to current. Provide and fix 4½-in. ogee moulded cast-iron eaves gutter, with 3-in. rain-water pipes, and connect with rain-water drain. Fit up round larder three tiers of 1-in. rubbed slate shelving, 12-in. wide as shown on plan, with rounded edge and rounded angle next doorway. The shelving to be carried on No. 12-in. wrought-iron brackets plugged to wall. Provide and screw into roof timbers No. 12 ½-in. screw hooks where directed. (Specify also method in which the walls and ceilings are to be plastered or otherwise treated.

The description of painting and decorative work can usually be included in the general specification unless they are specially varied.)

CHAPTER XXI.

REPAIRS.

IN writing a specification for repairs the student must be careful not to confuse this with a specification, or, more properly, a schedule, of dilapidations. The latter is generally written with inclusiveness as its chief quality, and is, therefore, usually vague rather than definite. As a guide to the method of specifying repairs our best plan will be to proceed through the various trades, noting especially matters in which this class of specification differs from that for a new building.

Bricklayer.

Defective Walls.—Describe the extent to which these are to be taken down and rebuilt; as for example:—Take down the upper part of front wall to a distance of 12 ft. 6 in. below top of parapet; and rebuild in 9-in. work in mortar to the same height as before. (Describe the kind of pointing. State if the old bricks from the pulling down are to be re-used.)

Pointing to Walls.—Describe the extent to which walls are to be pointed, where and how they are to be cleaned, if they are to be stained or coloured, and the description of pointing.

Pointing to Door and Window Frames.—State that the old pointing is to be raked out, and specify whether the new pointing is to be in lime and hair or in cement.

Resetting Stoves and Ranges.—State that the stoves and ranges which are to be reset are to be taken out and reset, the throating, flaunchings, covings, &c., being made good.

Chimney-pots.—State how many and what description, and make it clear whether they are to be in replacement of broken ones, or whether they are to be additional. In the

former case the old flaunchings ought to be removed in order to make a sound job of the setting of the new pots.

Mason.

Describe what stonework requires to be taken out and renewed, what is capable of being pieced, and what merely requires to be taken down and rebuilt. In the case of copings and other masonry continued in long lengths, it would frequently happen that part only requires renewing to a greater or lesser extent, and then the specification should define how much is to be renewed or repaired, as the case may be; as the common slipshod practice of specifying that the defective parts are to be taken out and renewed is likely to lead to difficulties, especially if competitive tendres are being invited from builders.

If the necessary repair or renewal of any work is of a very extensive character, it may be necessary to provide and specify shoring during the progress of the work.

In the case of worn steps, define whether they are to be taken out and entirely renewed or turned over and redressed, or whether pieces may be let in, or whether, if broken, they may be merely rejointed and cramped.

Paving would generally require to be taken up and relaid to current, with probably a new foundation and some part at least (query what part) should be renewed.

Slater and Tiler.

Specify how much, if any, of the roofing material is to be taken off and relaid, or whether merely the broken and defective slates or tiles are to be renewed. Also specify the renewal of pointing and torching to tiling, and the resetting and possibly the renewing of ridges and filleting.

Carpenter and Joiner.

The repairs in this trade are comparatively easy to specify, as generally speaking it is a case of entire renewal of broken or defective parts. Perhaps the most frequent exception to

this is in the case of treads of stairs where the necessities of the case may sometimes be met by renewing the nosing only. In any case where dry-rot exists the entire removal of all parts of the woodwork however slightly affected must be stringently enforced, and, of course, proper and adequate ventilation would have to be arranged.

The ironmongery is equally simple. If any which has to be renewed is to match any old work this must be specially mentioned as even if the patterns are simple they may be old-fashioned, and considerable difficulty may be experienced in matching. A careful estimator would make a considerable addition to the price of work which is to be matched.

Smith and Founder.

In this trade again repairs in the strict sense are almost out of the question. It is generally a question of renewal. Even in the case of stoves and ranges, which comprise by far the greater part of the repairs strictly so called in this trade, it is often cheaper and more satisfactory to renew the defective part, except in those cases where a special casting has to be dealt with.

Rain-water pipes, eaves gutters, and other rain-water goods are, of course, quite irreparable. In the case of ornamental balconies, balustrades and railings, it is a matter of importance to have the defective parts as a general rule replaced by others to match the remainder of the work, and this must therefore be clearly stipulated.

Whatever repairs in this trade are specified, the student must be quite sure that the repairs are possible, and cheaper than renewal, and should carefully explain in the specification the manner in which the repair is to be executed. Thus the student might consider the various ways in which the repair might be performed to a wrought-iron railing, the feet of the upright bars of which have been let into stone and run with lead, and have become decayed by galvanic action and rust. This is a condition of things which frequently exists, and is capable of several various methods of repair other than complete renewal.

Plasterer.

Ceilings.—Specify to what extent defective ceilings are to be cut down, whether or not the lathing is to be renewed, and what description of plastering is to be carried out.

Walls and Partitions.—Specify these in a similar way.

Cornices.—Define whether the whole of the cornices are to be renewed, or whether part only needs to be re-run, or whether stopping of cracks will meet the case. As regards enrichments, specify that they are to match those existing, or whether entirely new enrichments are to be put in.

Distempering.—Specify washing down and stopping, and clear-coleing if necessary. Particularly if enrichments are to be soaked and cleaned out, specify that they are to be cleaned of all whitewash down to plaster.

External Work.—Make it clear whether repairs are to be in similar materials to the existing, which may be of lime, stucco, or Roman cement, or whether it is to be done in Portland cement. Remember that patching up of defective external plastering is generally a very unsatisfactory performance, and usually has to be very speedily repeated.

Plumber and Zinc Worker.

The repair of external lead and zinc work generally consists simply of soldering. If this is what is desired it should be so stated, but if a more satisfactory and permanent repair is wanted, then partial or complete renewal of the lead or zinc must be specified. State, if the old lead is to be removed, what is to be done with it, whether the contractor is to take it away, in which case the most satisfactory and equitable proceeding is for the contractor to quote a price per cwt. which he will allow for the old lead, and for it to be weighed when stripped from the roofs. In dealing with internal work, repairs may be needed to joints or to pipes, the latter generally would be a question of renewal. With regard to fittings define precisely whether any or all are to be renewed or whether new washers or regrinding or other repair will satisfy the case.

Be careful to include a stipulation for cleaning of gutters.

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Be careful to include a stipulation for cleaning of gutters.

and flats in external work, and of traps and safes in internal work.

Painter, Glazier and Paperhanger.

The most important point for the student to define with regard to painter's work is the extent of the preparation for the paint, whether a mere washing down and sizing is sufficient, or whether rubbing down with pumice stone or burning off or removing with pickle are to be employed. When the work is prepared the painting will then generally be on similar lines, as far as the specification is concerned, to that of new work,

In the glazier's work repairs generally consist of hacking out and renewing broken glass, and the specification should define what constitutes a break. It is a very common practice to assume that one crack in a pane of glass is not a break, but that two cracks do constitute a broken pane. The removal and making good of decayed putty is also to be specified where required; and the cementings and attachments of lead lights, of course making it clear what quality of cementing material and connexion are required. In specifying repairs for paperhanger, in all good work, the walls, of course, would be stripped to the plaster, then stopped and sized before re-papering. Specify if the papering can be repaired with paper to match, which will only be likely to be the case when papering has been comparatively recently done, as patterns are rapidly superseded. Careful householders often preserve a piece or two of paper for repairs, but as that hung on the walls usually fades, the precaution, to be complete, should include the hanging up of the paper exposed to the light.

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